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Translation

TRANSLATIONS ON MAJOR USSR RIVER DIVERSION PROJECTS



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TRANSLATIONS ON MAJOR USSR RIVER DIVERSION PROJECTS Volume IV

CONTENTS

PREFACE	1
STATEMENTS BY POLITICAL LEADERS	
Excerpts From Proceedings of 26th CPSU Congress (Various sources, various dates)	2
Kunayev Speech, by D. A. Kunayev Rashidov Address, by Sh. R. Rashidov Krasnodarskiy Kraykom's Medunov, by S. F. Medunov Kirghizia's Usubaliyev Speech, by T. U. Usubaliyev Aksenov Report, by N. F. Aksenov Gapurov SpeechRadio Report, by M. G. Gapurov Gapurov Speech'PRAVDA' Version, by M. G. Gapurov 'TASS' Review of 28 February Session	
'The Basic Directions for Economic, Social Development' (PRAVDA, 5 Mar 81)	6
Tashkent Reports Existence of Plan To Provide Water to Uzbek SSR (Tashkent International Service, 6 Mar 81)	7
Rashidov Report on Post-Congress Tasks (PRAVDA VOSTOKA, 12 Mar 81)	8
Post-Congress Interview With Land Reclamation, Irrigation Specialists (D. I. Afonin Interview; PRAVDA VOSTOKA, 14 Mar 81)	10
Survey of Water Situation in Uzbekistan, Plans To Meet Challenge (N. Khudayberdyyev; GIDROTEKHNIKA I MELIORATSIYA, Mar 81)	13
Environmental Protection and River Diversion Endorced (GIDROTEKHNIKA I MELIORATSIYA, Apr 81)	19

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Realization of 'Lenin's Dream' for irrigation of Central	
Asia Urged (B. Lunin; PRAVDA VOSTOKA, 15 May 81)	20
Dzhurabekov on River Diversion (I. Kh. Dzhurabekov; PRAVDA VOSTOKA, 30 May 81)	30
ECONOMIC ASSESSMENTS	
Declining Level of and Prospects for Aral Sea (T. Abramova; SOTSIALISTICHESKAYA INDUSTRIYA, 15 Jan 81)	31.
New Goals for Land Reclamation Workers and Involvement in River Diversion (GIDROTEKHNIKA I MELIORATSIYA, Feb 81)	33
Sadykov, Lapkin, Antonov Stress Agricultural Benefits (A. Sadykov, et al.; IZVESTIYA, 4 Feb 81)	36
Improvement of Existing Irrigation Systems Advocated (Kh. Akhmedov; PRAVDA VOSTOKA, 14 Feb 81)	39
Academician Cites Problems of Caspian, Aral, Azov Seas (Ye. Fedorov; PRAVDA, 16 Feb 81)	41
Diversion of Siberia' Rivers Seen as 'Optimum Solution' (E. Rakhimov, L. Kamalov; PRAVDA VOSTOKA, 20 Feb 81)	42
River Reversal (S. Gushchev; NAUKA I RELIGIYA, Mar 81)	7171
Proposed River Diversion Cited as Economic Benefit for Nationalities (Albert Pin; NOVOYE VREMYA, 13 Mar 81)	46
Central Asian Desert Irrigation Projects (BAUERN-ECHO, 14-15 Mar 81)	47
Importance of River Diversion Insolution of Water Supply Problems (0. B. Kanatov; GIDROTEKHNIKA I MELIORATSIYA, Apr 81)	52
Socio-Economic Problems of Territorial Redistribution of Water	
Resources (Kuz'ma Ivanovich Lapkin, Eduard Davlyatovich; EKONCMIKA SEL'SKOGO KHOZYAYSTVA, May 81)	54
Progress on River Diversion Projects Reviewed (A. Kuchushev; TRUD, 6 Jun 81)	63
SCIENTIFIC AND TECHNICAL ANALYSES	
Soviet Hydrologist Says River Diversion Not a Near-Term Solution (Editorial Report)	65

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Review of Book by S. L. Vendrov on Problems of Transformation of USSR River Systems (N. I. Makkavayev; IZVESTIYA VSESOYUZNOGO GEOGRAPHICHESKOGO OBSHCHESTVA, Jan-Feb 81)	66
Wider Use of Blasting for Canal Construction Advocated (N.S. Grishenko, et al.; GIDROTEKHNIKA I MELIORATSIYA, Mar 81)	70
Selection of Strategy for Utilization of Water Resources, Including River Diversion, Discussed (A. I. Duvanin; VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA, Mar-Apr 81)	77
Discussion of Scientific Studies on Using Volga Water Resources (G. V. Voropayev, T. N. Ivanova; VODNYYE RESURSY, No 2, 1981)	82
River Reversal Project Discussed by Turkmen Geographer (A. Zhumashov; TURKMENSKAYA ISKRA, 15 Apr 81)	89
Possible Changes in Environment and Its Protection in Sphere of Activity of Diverting Part of the Streamflow on European Territory of USSR (R. Z. Gareyshin, et al.; VESTNIK MOSKOVSKOGO UNIVERSITETA.	
SERIYA 5: GEOGRAFIYA, Mar-Apr 81)	93
Need for Redistribution/Diversion of Water Between Volga and Ural Rivers Discussed	
(A. P. Musatov, Yu. N. Podushko; VODNYYE RESURSY, No 2, 1981)	101
GLOSSARY OF SELECTED TERMS	107
RUSSIAN ACRONYMS	109

- c -

PREFACE

This is the final volume of the four-volume special report on major Soviet river diversion projects. Translations of reports or discussions on proposals for or ramifications of projects to divert part of the flow of certain major northward flowing river systems into areas of the southern USSR, especially Kazakhstan and Central Asia are included. As with previous editions, the material in this series is divided into statements by political leaders, economic assessments and scientific-technical analyses. Articles are arranged chronologically within these categories.

This collection of translations was prompted by a notable increase in the volume of material published on the feasibility of major river diversion projects. The greatest portion of this material was published from the latter part of 1980 through June 1981. The material selected is from a broad range of Soviet central and republic newspapers and journals, in the local languages of the Central Asian republics as well as in Russian.

As a further aid to the reader this edition includes a brief glossary of selected Russian language terms as well as a list of expansions for pertinent Russian language acronyms.

While this is the last volume in the series devoted uniquely to river diversion projects it is not the end of reporting. Material on Soviet river diversion projects appearing hereafter will be published in the Regional Development section of the USSR AGRICULTURE REPORT.

STATEMENTS BY POLITICAL LEADERS

EXCERPTS FROM PROCEEDINGS OF 26TH CPSU CONGRESS

Kunayev Speech

LD161657 Moscow PRAVDA in Russian 25 Feb 81 p 2

[Speech delivered by D. A. Kunayev, first secretary of the Kazakh Communist Party Central Committee, at 24 February morning session of the 26th CPSU Congress]

[Excerpt] Big grain harvests, the faster development of stockraising and the improvement of rural and urban living standards all depend in the closest possible way on the future solution of water-supply problems.

We are already using to considerable effect exposed and underground springs, the unique, 500-km-plus Irtysh-Karaganda Canal, which is being extended to Dzhezkazgan, and 1,000-km aqueducts in north Kazakhstan and the irrigation systems in the south.

But for a cardinal solution of the water-supply problems of Kazakhstan and Central Asia and for the stable development of their economies in the future we believe it is necessary to complete as early as during the 11th 5-Year Plan the preparatory work for diverting part of the flow of Siberian rivers into Kazakhstan and Central Asia and, in the process, to envisage measures to stabilize the level of the Aral Sea. (applause) The loss of the sea would have a disastrous effect on the fate of the virgin lands that have been opened up and on other extremely vital issues, which is something we have no right to allow. The time has also come to expedite the construction of the Volga-Ural canal. (applause)

Rashidov Address

LD261615 Moscow PRAVDA in Russian 25 Feb 81 pp 3-4

[Speech delivered by Sh. R. Rashidov, first secretary of the Uzbek Communist Party Central Committee, at 24 February morning session of the 26th CPSU Congress]

[Excerpt] In his report to the party congress Leonid Ilich Brezhnev stressed most forcefully the need to elaborate a special food program for the country.

2

The redirection of part of the flow of the northern rivers into the Volga River basin and the waters of Siberian rivers into Kazakhstan and Central Asia would be an immense contribution to the implementation of this program. There are tens of millions of hectares of land in the area to be opened up. It is rich, fertile land, a land bathed in sunshine, a land of nourishment, and there are able farmers to work it. (applause)

Our congress will discuss and adopt the basic guidelines for the development of the country's national economy for 1981-85 and for the period through 1990. A positive solution of the question of redirecting part of the flow of Siberian rivers, which Comrade D. A. Kunayev talked about in his speech here, will permit the creation of a new unique and highly productive region of irrigation farming and will be a major contribution to the solution of the food program. (applause)

Rashidov Address Comparison

[Excerpt] A comparison of the item entitled "Rashidov Address" with a report of the Rashidov speech at the 26th CPSU Congress published in the Tashkent PRAVDA VOSTOKA in Russian on 25 February on page 3 reveals the following sole variation:

PRAVDA VOSTOKA rewords and adds to read: "...of Siberian rivers into the RSFSR, Kazakhstan and Central Asia could make an immense contribution to resolving it. There are tens...."

Krasnodarskiy Kraykom's Medunov

LD031137 Moscow PRAVDA in Russian 26 Feb 81 pp 3-4

[Speech delivered by S. F. Medunov, first secretary of Krasnodarskiy Kraykom, at 25 February morning session of the 26th CPSU Congress]

[Excerpt] It is necessary for both central planning organs and agricultural organs to adopt a comprehensive approach to the examination of the kray's potential for agricultural production.

We believe in the kray that it is expedient to concentrate efforts on increasing the production of high-quality food and seed grain—wheat and corn, rice and soybeans, sunflowers, beets and vegetables, the seed of alfalfa and other crops which cannot be grown in other parts of the country. This approach accords with the requirement put forward in Leonid Ilich Brezhnev's report.

Among the measures insuring the Kuban's transformation into a zone of stable, highly commercial agriculture regardless of the weather, it is necessary to implement in practice the plans being elaborated to divert part of the flow of northern rivers via the Volga to the northern Caucasus. In the long term this will insure the kray's annual production of about a billion poods of grain and the cultivation of a sufficient quantity of fodder crops for highly intensive livestock raising.

Kirghizia's Usubaliyev Speech

LD011301 Moscow PRAVDA in Russian 27 Feb 81 pp 3-4

[Speech by T. U. Usubaliyev, first secretary of the Kirgiz CP Central Committee, at 25 February evening session of the 26th CPSU Congress]

[Excerpt] I would like to emphasize the existence of large water resources in this zone. The Sarydzhaz River alone has an annual flow of over 4 billion cubic meters. The redirection even of less than half of this flow into the Issyk-Kul Basin and the Chuyskaya Valley would insure the stabilization of the level of Lake Issyk-Kul, improve the conditions of this report zone of union importance and make it possible to irrigate over 200,000 more hectares of fertile land.

This would make it possible to increase considerably the output of agricultural products.

By developing the hydraulic power resources of the Sarydzhaz River and its tributaries, the Central Asian republics and Kazakhstan will receive over 5 billion kilowatt-hours of electricity a year.

Aksenov Report

LD021221 Moscow PRAVDA in Russian 27 Feb 81 p 7

[Speech delivered by N. F. Aksenov, first secretary of Altayskiy Kraykom, at 26 February morning session of the 26th CPSU Congress]

[Excerpt] It is well known, comrades, that the shortage of moisture accounts for the shortfall in the grain and fodder harvest in the steppe regions of Siberia. So there is a pressing need to further intensify work on land irrigation and to more rationally use arable land, above all for the development of grain production. The USSR Gosplan should take this more fully into account when resolving problems of the redistribution of Siberia's water resources.

Gapurov Speech--Radio Report

LD261144 Moscow Domestic Service in Russian 0930 GMT 26 Feb 81

[Report on speech by M. G. Gapurov, first secretary of the Turkmen Communist Party Central Committee, at the 26 February session of the 26th CPSU Congress in the Kremlin Palace of Congresses—with portions recorded]

[Excerpt] Comrades, in the 11th 5-Year Plan the fuel and power complex will develop at a rapid rate in the republic, and the construction of the Karakumiskiy canal named after Vladimir Ilich Lenin will be continued. However, there are also certain complications. In agriculture, millions of hectares of fertile virgin land with a good climate are not being used because of a shortage of irrigation water and land-improvement work. That is why we are counting on more effective assistance from the USSR Gosplan, and the USSR Ministry of Land

4

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Reclamation and Water Resources in supplying the required capital investments for this purpose.

Comrade Kunayev and Comrade Rashidov put forward in their speeches a proposal for the construction of hydro-technical facilities to divert part of Siberian rivers to Kazakhstan and Central Asia. We support this proposal and ask the CPSU Central Committee and the USSR Council of Ministers to take a positive decision on it. [applause] [end recording]

Gapurov Speech-- 'PRAVDA' Version

LD011501 Moscow PRAVDA in Russian 27 Feb 81 pp 5-6

[Speech delivered by M. G. Gapurov, first secretary of the Turkmen CP Central Committee, at 26 February morning session of the 26th CPSU Congress]

[Excerpt] Comrades: In the 11th 5-Year Plan the fuel and energy complex will develop at increasing preferential rates in the republic. Gas extraction will reach 81-83 billion cubic meters per year, electricity generation will increase 80 percent, oil refining will double and mineral fertilizer production will almost treble. The construction of the V. I. Lenin Karakumskiy Canal will continue. However, there are certain difficulties in the way of this. In agriculture millions of hectares of fertile virgin land with a favorable climate are not being used because of the shortage of irrigation water, and land reclamation work needs to be carried out on them. For this reason we are hoping for more effective assistance from the USSR Gosplan and the USSR Ministry of Land Reclamation and Water Resources in earmarking the requisite capital investments for these purposes. In their speeches Comrades D. A. Kunayev and Sh. R. Rashidov suggested starting the construction of hydraulic engineering installations to divert part of the flow of Siberian rivers into Kazakhstan and Central Asia. We support that proposal and we ask the CPSU Central Committee and USSR Council of Ministers to decide in favor of it [reshit ego polozhitelno]. (applause)

'TASS' Review of 28 February Session

LD281330 Moscow TASS in English 1253 GMT 28 Feb 81

[Excerpt] Moscow, 28 Feb, TASS--Today, on the sixth day of the work of the 26th Congress of the CPSU, the delegates continued discussing the report "Guidelines for the Economic and Social Development of the USSR for 1981-1985 and for the Period Ending in 1990", delivered by Nikolay Tikhonov, the head of the Soviet Government, on Friday.

In this document, Vladimir Gusev, the first secretary of the Saratov Regional Committee of the CPSU, said at the congress today, much attention is devoted to matters aimed at developing agriculture. The speaker showed the possibilities of irrigated farming on the example of Saratov region which is situated in the arid steppes beyond the Volga. "Life has convincingly proved that irrigation is the most reliable way to high and stable yields," he said. Much more irrigated lands than before is to be brought into cultivation in Saratov region in the current five-year period. This will create conditions for the region's more tangible participation in the implementation of the country's food programme, he said.

CSO: 1829/234

5

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'THE BASIC DIRECTIONS FOR ECONOMIC, SOCIAL DEVELOPMENT'

LD051300 Moscow PRAVDA in Russian 5 Mar 81 pp 1-7

["Text" of "The Basic Directions for the Economic and Social Development of the USSR for 1981-85 and for the Period Through 1990"]

[Excerpt] Work is to be expedited on the reconstruction of existing land improvement systems and improvement of their water supplies, together with the elimination of their salinity and high level of soil acidity.

Preparatory work is to be commenced on transferring part of the outflow of northern rivers to the Volga River Basin, as well as continuing the scientific and design studies for diverting some of the water from Siberian rivers to Central Asia and Kazakhstan.

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TASHKENT REPORTS EXISTENCE OF PLAN TO PROVIDE WATER TO UZBEK SSR

GF071542 Tashkent International Service in Uzbek 1700 GMT 6 Mar 81

[Text] Twenty-one large irrigation networks have been constructed in the Kyzylkum Desert of Uzbek SSR, which covers a large portion of the northern part of the country. The completion of the networks will provide for increased (agricultural) produce in the Uzbek SSR.

In line with the current Soviet 5-year socioeconomic development plan, which has been ratified by the 26th CPSU Congress, the dry regions of the Uzbek SSR will be provided with water. A (?plan) has been drawn up by the (?state resources directorate) for supplying water to such areas.

CSO: 1810/079

7

RASHIDOV REPORT ON POST-CONGRESS TASKS

LD251031 Tashkent PRAVDA VOSTOKA in Russian 12 Mar 81 pp 1-3

[UZTAG Report: "The 26th CPSU Congress Decisions--Into Action: A Meeting of the Republic's Party Aktiv"]

[Excerpts] Water resources construction is being carried out on a large scale in the republic. The operation of the water resources systems and the reclaimed condition of the land are improving yearly. The resources being invested in water resources construction give a high return. At the same time we have instances of the misuse of resources, and cases of capital investments being diverted to other goals are persisting.

In accordance with the decisions of the 26th party congress, it is planned to open up about 500,000 hectares of new lands in the republic during the 11th 5-Year Plan. The development of large tracts in the Karshinskaya, Golodnaya and Dzhizakskaya Steppes and the construction of reservoirs, irrigation channels and pumping stations will continue. Work on improving the operating service will be promoted.

The republic's Gosplan, the Ministries of Land Reclamation and Water Resources, Agriculture and Fruit and Vegetable Farming, the Glavsredazirsovkhozstroy and party and soviet organs should ensure the construction and commissioning of water resources projects strictly according to plan and within the set deadlines.

Long-term forecasts for the next 5-year period assume a low water level and an increasing shortage of water resources. This supposition is already beginning to be borne out. A complex situation is emerging in water resources as a result of insignificant precipitation last December and in the current year, and of an inadequate reserve of moisture. Under these conditions the task of accelerating in every way the planned work on overcoming the water shortage is looming large. Monitoring of the distribution and use of irrigation water must be stepped up.

An important role is assigned to chemicalization in resolving tasks of the further expansion of agriculture. We receive many mineral fertilizers, herbicides, defoliants and other chemical resources. The increase in yield depends on their correct application. Mention must be made of this because we still do not always achieve a high return from the use of fertilizers and other chemical resources. We have set up the Uzselkhozkhimiya Science-and-Production Association and established its organs in the oblasts and rayons. But there has been no perceptible improvement

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in the chemicalization service. The association exerts only a weak influence on improving the use of fertilizers by kolkhozes and sovkhozes.

The Ministry of Agriculture must take measures to strengthen this sector of work, establish closer links with science and draw up proposals for a radical improvement in the use of chemical resources--primarily mineral fertilizers--on kolkhozes and soykhozes.

A crucial period has now begun in agriculture. Rural workers are preparing to greet the sowing campaign fully equipped. Once again it is necessary to examine thoroughly the readiness of every farm for field work, and to check the complete readiness of equipment and the provision of machine operator cadres for each unit, and the supply of seeds, mineral fertilizers and plant-protection agents. Taking the anticipated low water level into account, it is necessary to increase the rate of irrigation rate, stockpile more organic fertilizers, bring pumping plants into a state of readiness and step up work in orchards and vineyards. The sowing of alfalfa, grain crops, corn and early vegetables must be completed in the next few days. And, of course, the cotton sowing must be performed to a high agrotechnical standard and seedlings must be obtained on natural moisture.

CSO: 1829/238

POST-CONGRESS INTERVIEW WITH LAND RECLAMATION, IRRIGATION SPECIALISTS

Tashkent PRAVDA VOSTOKA in Russian 14 Mar 81 p 2

[Interview with D. t. Afonin, deputy minister of land reclamation and water management of the Uzbek SSR; V. G. Mitskevich, head engineer of the irrigation administration of the republic Ministry of Agriculture; and V. A. Dukhovnyy, director of the Central Asian Scientific Research Institute of Irrigation imeni V. D. Zhurin, candidate of technical sciences, by I. Lyubovskiy, supernumerary correspondent: "Water--The Ally of the Harvest"]

[Text] Recently in Namangan there was a meeting of the republic aktiv of agricultural and water management workers which was devoted to the effectiveness of the utilization of irrigated land in Uzbekistan. Our supernumerary correspondent I. Lyubovskiy met with participants in the congress—D. I. Afonin, deputy minister of land reclamation and water management of the Uzbek SSR; V. G. Mitskevich, chief engineer of the irrigation administration of the republic Ministry of Agriculture; and V. A. Dukhovnyy, director of the Central Asian Scientific Research Institute of Irrigation imeni V. D. Zhurin—and requested that they discuss the development of land reclamation in the republic as well as tasks arising from the decisions of the 26th CPSU Congress.

[Question] What results did land reclamation workers of Uzbekistan achieve under the Tenth Five-Year Plan and what are the main tasks facing them under the current Five-Year Plan?

[D. I. Afonin] The years of the last Five-Year Plan, especially the last three, were not easy for the republic's farmers. It was necessary to overcome the difficulties of prolonged spring rains, the runoff of mud streams and the shortage of water during the height of the summer growing period. Drawing on lessons from past years, the land reclamation workers of Uzbekistan prepared well for the 1980 growing period. In the oblasts they promptly conducted current and reserve irrigations and accumulated 5.4 billion cubic meters of water in the reservoirs, which is a billion more than the supplies of the preceding year. They accumulated 5.2 billion cubic meters of water more than previously in the interrepublic water reservoirs as well.

But still the growing period irrigations were conducted under difficult conditions in 1980. At the end of July and the beginning of August there was an especially small amount of water. The supplies accumulated in the water reservoirs were

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expended intensively. Water management workers made use of all existing wells and drilled new ones, and they installed mobile pumping stations at the collectors. All measures were taken for economical expenditure and efficient utilization of water. At the price of a large amount of hard work the land reclamation workers managed to provide water for all irrigated land, which contributed significantly to the rich harvest of cotton.

Intensification of agricultural production and increased productivity now depend more and more on the level of operation of the land reclamation service. Under the Eleventh Five-Year Plan we will have to increase the area of irrigated land by 500,000 hectares with very limited water resources. Amelioration work will have to be done on 1.1 million hectares. In order to increase the effectiveness of the utilization of irrigated land and improve the operational service, progressive kinds of drainage will be introduced and many main and interfarm collectors will be reconstructed. Land reclamation workers of the republic are preparing intensively for this year's growing period. They have already overfulfilled the assignment for cleaning the intrafarm irrigation network, have completed the cleaning of the interfarm irrigation network and have completed leaching irrigations in the majority of oblasts of the republic. Water management workers of the Uzbekistan have resolved to complete the preparation of the irrigation systems ahead of schedule—by 25 March.

[Question] What are the condition and the prospects for the development of the intrafarm land reclamation network in the republic?

[V. G. Mitskevich] Despite a certain amount of technical support, the existing intrafarm land reclamation systems can not be considered complete. Technically a complete system must be coordinated with the means and the technology for irrigation. Unfortunately, the overall area of irrigated land with irrigation charts covering 0.5-10 hectares in 1976 exceeded 900,000 hectares. This made it considerably more difficult under the Tenth Five-Year Plan to introduce mechanization extensively and use technical irrigation equipment in agricultural work. As of today 1,645,000 hectares required comprehensive restructuring. Taking into account the need for economical expenditure of water, this problem is now no less crucial than the assimilation of new land.

Under the Eleventh Five-Year Plan we intend to comprehensively restructure the land on an area 125,000 hectares. This will make it possible to increase significantly the efficiency factor of intrafarm land reclamation networks, to reduce water losses from filtration considerably, to provide the irrigation network with the necessary hydrotechnical structures and equipment, and to begin to introduce the "Automated Control System-Irrigation" everywhere on the farms.

Water management workers of the republic have done a large amount of work directed toward improving the operation of main and interfarm collectors, canals and water reservoirs and applying automated equipment and telemechanics. The time has come to introduce all this into intrafarm land reclamation networks as well.

[Question] How are you solving the problem of increasing irrigation water resources in the republic?

11

[V. A. Dukhovnyy] Under the Tenth Five-Year Plan a significant amount of work was done for utilizing water efficiently, reducing nonproductive expenditures of it, regulating river flows and improving the land. This made it possible to halt the advancing shortage of water. At the same time the difference between the existing water resources and the consumption of water is decreasing more and more. In particular, the water of the Syrdar'ya is now being fully utilized. Moreover, the consumption of water from the Syrdar'ya exceeded its flow by 24 percent as a result of the recycling of water. The utilization of water from the Amudar'ya amounts to 87.6 percent. The provision of water is less than 90 percent for about 18 percent of the land in Uzbekistan.

One of the most important tasks of the decade is to accelerate the work for diverting part of the flow from Siberian rivers into Central Asia. But in doing this it is necessary to utilize all existing water resources efficiently and economically. In order to increase the effectiveness of the utilization of water, it is necessary to reconstruct water management systems on the basis of the application of modern types of drainage in combination with progressive designs for the irrigation network, technical irrigation equipment and leveling of the sections. The introduction of an efficient structure for the planted areas through the application of regular crop rotations also produces a large effect. A combination of modern technical equipment for irrigation and improved types of drainage makes it possible to introduce optimal land reclamation conditions. This will make it possible to reduce expenditures of water on leaching and also to reduce evaporation.

11772

CSO: 1829/219

SURVEY OF WATER SITUATION IN UZBEKISTAN, PLANS TO MEET CHALLENGE

Moscow GIDROTEKHNIKA I MELIORATSIYA in Russian No 3, Mar 81 pp 2-6

[Article by N. Khudayberdyyev, chairman of the Uzbek SSR Council of Ministers: "Toward a New Rise in Irrigation Farming in Uzbekistan"]

[Text] The Soviet people greeted the 26th CPSU Congress with profound enthusiasm.

The report by General Secretary of the CPSU Central Committee Comrade L. I. Brezhnev, "The Report of the CPSU Central Committee to the 26th Congress of the Communist Party of the Soviet Union and Upcoming Party Challenges in the Field of Domestic and Foreign Policy," was received as a major new step in creative development of Marxist-Leninist science and as a document of vast political and theoretical importance. The new goals of national economic development were clearly and concretely outlined in the report by Comrade N. A. Tikhonov, chairman of the USSR Council of Ministers. The work of the congress, the statements of delegates, and the resolutions that were adopted had enormous impact not only in our country, but throughout the world.

The documents of the congress and draft "Basic Directions of Economic and Social Development of the USSR for 1981-1985 and the Period Until 1990," which were adopted after nationwide discussion, name as one of the most important problems of building communism the program for further development of the agroindustrial complex and taking far-reaching steps to reliably supply the country with food and agricultural raw material.

In Uzbekistan the major challenges of intensive development of agricultural production, and of cotton growing, the principal sector here, are being resolved through consistent implementation of CPSU agrarian policy.

During the 10th Five-Year Plan the cotton growers of the republic sold more than 28.5 million tons of raw cotton to the state, 932,000 tons more than envisioned by the plan and 4.04 million tons more than was sold in the Ninth Five-Year Plan. A record amount, 6,237,000 tons of raw cotton, was delivered to procurement points in the last year of the five-year plan. Cotton yield rose to 3.32 tons per hectare.

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The Uzbek SSR was awarded the Order of Lenin for the third time for its outstanding success in carrying out the decisions of the 25th CPSU Congress with respect to the development of cotton growing and for successful fulfillment of the 10th Five-Year Plan assignments for state purchases of cotton, grain, vegetables, melons and potatoes, grapes, fruit, and ambary [kenaf].

In Uzbekistan, as also in the other fraternal republics of Central Asia, irrigation is the key factor in the development of productive forces and the foundation and basic means of intensifying agricultural production.

A total of 13.3 billion rubles of capital investment has been invested in water management construction since the May 1966 Plenum of the CPSU Central Committee. The republic's irrigated area has more than quadrupled in this time.

Each year the republic incorporates roughly 100,000 hectares of new irrigated lands. The Golodnaya Steppe, where the methods of integrated development of virgin desert land was worked out and tested, has become a kind of laboratory. A major region of highly efficient cotton growing has been established there on the basis of irrigating 300,000 hectares using fundamentally new organizational and technical concepts. The experience of development of Golodnaya Steppe remains unsurpassed in the world. The knowhow acquired there is being used extensively in development of virgin lands in the Karshinskaya, Surkhan-Sherebadskaya, and Dzhizakskaya steppes and large rice-growing areas in Karakalpakskaya ASSR and other regions of Uzbekistan.

The expansion and intensification of irrigation farming in Uzbekistan demands enormous water consumption. Soil and climatic conditions in the republic make it necessary to use water both for water supply and for major and annual flushing to remove salts from the soil. At the same time water consumption in industry and the municipal-domestic sector grows each year.

All these things taken together have led us to a situation where we are already today experiencing a water shortage. The situation is aggravated by the fact that every year water management and agricultural workers in certain parts of Uzbekistan or throughout the republic are forced to struggle with bad precipitation years. 1974, 1975, and 1977 were especially memorable years; the loss from lack of water exceeded 200,000,000 rubles a year. Water was delivered only to the cotton plantations. Fields of extremely valuable feed and vegetable crops, the rice fields of the Fergana valley and the Tashkent and Zarafshan oases, orchards, and vineyards had to be put on "starvation rations."

Water supply to developing sectors of the republic economy is becoming an acute problem which demands an immediate solution in the interests of continued economic growth. The paramount issues are rational, more efficient use of water resources, water economy, and protecting water sources against contamination and depletion. In connection with this the republic has worked out and is implementing a broad program of water management activities. The comprehensive program envisions completion of work to regulate the flow of the rivers to increase the water supply to irrigated lands; a reduction in water losses from main canals by the use of antifiltration lining, and from the distribution network by the use of chutes

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and pipes; an improvement in irrigation equipment; extensive drainage construction; a decrease in water use for flushing and irrigation by using mineralized water; reorganization and modernization of irrigation systems; automation of water distribution, and so on.

Work to regulate the flow of the river is going forward on a broad front. Construction of the enormous Andizhan reservoir on the Karadar'ya River and the Charvak reservoir on the Chirchik has been completed. The establishment of a system of reservoirs (including the Toktogul reservoir on the Naryn, which was built earlier) makes it possible to carry on effective long-term regulation of the flow of the Syrdar'ya River.

A unique dam has been built across the channel of the Amudar'ya near Tyuyamuyun. The new reservoir, together with the Nurek reservoir on the Vakhsh, will improve seasonal regulation of the flow of the Amudar'ya. Small reservoirs to regulate the flow of small rivers and streams are also under construction.

As the result of regulation the total volume of available river flow in the republic was increased by 17 cubic kilometers a year. The volume of use of underground water, which is consumed within the limits of annually renewed resources without detriment to the environment, reached 3.6 cubic kilometers a year. More than 600 wells of various types are built for this purpose each year. The volume of interbasin diversions is growing. Very large series of pumping stations such as the Amubukhara, Amuzang, Besharyk, and many others deliver up to seven cubic kilometers of water from the Amudar'ya and Syrdar'ya to the low-water basins of the Zarafshan, Surkhan and other rivers.

Each year up to 1,000 kilometers of canals are lined with concrete. Hundreds of kilometers of canals have been laid in strongly permeable ground with kapron and polymer coatings which insure an efficiency of 0.98-0.99. The area of irrigation systems constructed using reinforced concrete chutes and enclosed pipes with efficiency levels of 0.78-0.85 is constantly increasing. The introduction of closed low-pressure Farkhad-1 pipes makes it possible to practically eliminate loss from the regulated system.

Improvements in watering technology are aimed at reducing water losses in the field. A transition is being made from "ok-aryki" [possibly traditional Central Asian irrigation structures] to flexible watering pipes. The production of flexible pipe in the republic has passed 2,000 kilometers a year. Movable aluminum pipe has begun to be used, and plans call for the development of drip irrigation for orchards and vineyards.

Considerable attention is devoted to improving and maintaining the optimal level of groundwater by drainage systems. More than 88,000 kilometers of open and closed drainage systems have been built and are in operation. Vertical drainage is developing intensively. All this makes it possible to move toward optimization of land improvement regimes, a reduction in total water consumption, and wider use of mineralized waters. The use of mineralized waters for irrigation has reached three cubic kilometers a year in the republic.

15

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Automation of water distribution, the introduction of automated control systems such as the Zarafshan, Southern Goldnaya Steppe Canal, Fergana, and many others, helps reduce water loss from canals.

More and more work is being done on the reorganization and modernization of irrigation systems and switching some irrigated lands to water supply from the new canals. In just the next five years plans envision the construction of more than 35 pumping stations and 17 reservoirs on small rivers and streams.

In the current five-year plan the rate of comprehensive upgrading of irrigated land is to increase sharply. The water management organizations of the republic have a large construction industry base for this purpose. The capacities of the reinforced concrete article plants exceed 1.5 million cubic meters of reinforced concrete a year, while our enterprises can produce 2,500 kilometers of drainage pipe and 4 million cubic meters of sorted gravel. Such a construction base makes it possible not only to develop irrigation, but also to sharply increase the level of operation of existing irrigation systems. The republic has established an operating base for water management facilities that insures their operation on an industrial basis.

The steps that have been taken to increase the water available to irrigation systems have had a significant impact. In the last 10 years the efficiency of their use for the republic as a whole grew from 0.43 to 0.61. Further steps will make it possible to raise this figure to the level already achieved in the most advanced systems. But no matter how efficient all these steps are, they cannot prevent a growing shortage of water in the region. As scientific research and calculations demonstrate, the available water resources of the Syrdar'ya and Amudar'ya can only support the development of irrigation for a few years into the future.

The potential area of land suitable for irrigation in Uzbekistan is estimated to be 7.5 million hectares; taking into account the possibility of highly complex land improvement measures it could be 12 million hectares. But even if all the water resources of the Aral Sea basin are used fully and economically, the area of irrigated land in the republic, which today is 3.4 million hectares, can only be increased to 4.2-4.4 million hectares. In other words, considering the water constraint the reserve for land development is about 1 million hectares. Given a continuation of the existing rate of water management construction, where up to 100,000 hectares of irrigated lands are put into use in the republic each year, this reserve will be exhausted in 10 years. Even if the most austere measures are taken toward economical and rational use of water, the water resources of the Amudar'ya River basin will be completely developed by 1988-1990, and the waters of the Syrar'ya River will be put to full use even earlier.

With the worsening shortage of water resources, it is inevitable that negative consequences will ensue, to the substantial detriment of the environment. First of all, the already-high mineralization of river waters will grow. Already today, the minera ization of the water in the middle and lower courses of the Syrdar ya in an average water year reaches the maximum tolerable concentration. This process will go further in the future and in the coming decade the salt content in irrigation

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with such water will inquestionably worsen the condition of the land, lead to the accumulation of salts in the soil, and prevent us in the future not only from increasing the yield of agricultural crops, but even maintaining yield at the level attained. A similar picture is observed in the basin of the Amudar'ya River. Intensive salinization of the land will inevitably lead to an increase in the volume of water used for flushing, which again will increase the water shortage.

According to calculations by scientists, with the most economical and rational use of the internal water resources of the republic only, the growth rate of agricultural production attained in Uzbekistan cannot be maintained beyond 1990. Further development of irrigation farming, and of the entire agroindustrial complex of Uzbekistan, can only be accomplished by bringing in water from other regions that have more water available.

The constant concern of our party for the development of productive forces of the Central Asian republics was vividly manifested in the decision of the 25th CPSU Congress to carry out scientific research and planning work during the 10th Five-Year Plan in relation to the problem of diverting part of the flow of the Siberian rivers to Central Asia and Kazakhstan. This ancient dream of the people has now, under conditions of mature socialism, acquired a practical foundation for the first time.

As research and calculations show, diverting even a comparatively small part of the flow (25-60 cubic kilometers) of the great rivers of Siberia would offer enormous prospects for further socioeconomic development of the RSFSR, the Kazakh SSR, and the Central Asian republics.

The diversion of Siberian water to the Aral Sea basin will increase the volume of water resources of the basin 1.5 times and make it possible to increase more than two times the area of irrigated land in the Central Asian republic and Southern Kazakhstan. It will enable us to raise cotton production in this region to 11-12 million tons and significantly expand rice, corn, and vegetable fields, and orchards and vineyards. Favorable conditions will be created for the further development of animal husbandry.

The effect of diverting part of the flow of the Siberian rivers to the south is not restricted to the sphere of agricultural production. It will support the development of existing and formation of new territorial industrial complexes, which will make it possible to significantly increase the volume of industrial production in the region.

Construction of the diversion canal will make it possible to develop the land and minerals all along its route. Highways and railroads will be laid along the canal, and dozens of settlements and cities will arise in the canal zone. The enormous scale of work will demand hundreds of thousands of workers, some from the densely populated regions of Central Asia. This will promote rational use of the labor resources of the Central Asian republics.

17

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Commades D. A. Kunayev, Sh. R. Rashidov, and M. G. Gapurov spoke at the 26th CPSU Congress of the necessity of beginning hydro engineering work on diverting part of the flow of the Siberian rivers to Kazakhstan and Central Asia.

The groundwork for solving this grandiose problem has been laid by all the experience of our country in water management construction, including the White Sea-Baltic, Volga-Baltic, and Volga-Don canals and the North Crimean and Kakhovka main canals. The Karakum canal is essentially of model of the projected diversion canal, reduced to one-fourth size. The Karshinskiy series of pumping stations and the Amubukhara machine canal are considered analogs of transfer structures. It is interesting to note that the cross-section of the Farkhad derivative canal, which was built during the Great Patriotic War almost without machinery, is only half the size of the cross-section of the diversion canal.

The enormous army of highly skilled workers and hydro engineering specialists available in our country, armed with powerful modern machinery, can solve problems on any scale very rapidly.

The working people of Uzbekistan together with the working people of the other Central Asian republics are ready to take a very active part in carrying out the plan to divert the water of the Siberian rivers to the Aral Sea basin. The largest planning and scientific research institutes in the republic, the Central Asian State Institute for the Planning of Irrigation Structures and Rural Electric Power Plants and the Central Asian Scientific Research Institute of Irrigation, in cooperation with scientific institutions in Moscow, Leningrad, and various other Union republics are already doing a significant part of the work on the problem. Dozens of other planning organizations in the republic are ready to join the work. The water management construction organizations, who incorporate up to 1.5 billion rubles of capital investment a year for construction and installation work, have an enormous stock of earthmoving machinery and are capable of performing large amounts of work on the diversion canal line. The Uzbek SSR Ministry of Agriculture and Uzkolkhozstroy [Kolkhoz Construction] can be called in to participate in construction work.

The higher and secondary schools, vocational-technical schools, and educational combines of the republic train hundreds of construction, power, and mechanical engineers and thousands of skilled workers each year. They can be used in construction of the canal.

The arrival of Siberian water will provide a mighty impetus to further development of the entire economic complex of Uzbekistan. Vast prospects will open for a new upsurge in agriculture and industrial production in the other Central Asian republics and Kazakhstan as well. Development of large areas of land in the diversion canal zone will create conditions for the production of many millions of tons of grain, corn, rice, vegetables, melons, fruits, and grapes and hundreds of thousands of tons of meat and milk. This will be a significant contribution to carrying out the party's food program and implementing the economic strategy of the Communist Party of the Soviet Union, whose principal objective is a steady improvement in the living conditions of Soviet people.

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18

ENVIRONMENTAL PROTECTION AND RIVER DIVERSION ENDORSED

Moscow GIDROTEKHNIKA I MELIORATSIYA in Russian No 4 April 81 pp 2-5

[Lead Article: "Mighty Stimulus for New Achievements"]

[Excerpt] At the CPSU Congress special attention was devoted to questions of the protection of nature and the rational utilization of natural resources. It was pointed out in the report of CPSU Central Committee General Secretary L. I. Brezhnev that in the eighties there will be an increase in expenditures for protecting the environment. In the program adopted by the Congress "Basic Directions in the Economic and Social Development of the USSR for 1981-1985 and for the Period to 1990" a complex system of scientific-technical, economic and social measures directed at the solution of the ecological problem is envisaged.

The Congress pointed out the necessity to improve protection of water sources, including small rivers and lakes, from exhaustion and pollution, and also to continue work in protection and rational utilization of natural complexes and first and foremost the Baykal.

The resolution of the creation of automated control systems for water management complexes in river basins in the European part of the country and Central Asia, reinforced by the instructions on the necessity for large scale output of instruments and automated stations for monitoring the environment is extremely important.

Commencement of preparatory work for diversion of part of the flow of northern rivers into the Volga River basin and continuation of scientific and planning studies for diversion of Siberian river water into Central Asia and Kazakhstan have been recognized as necessary for the cardinal resolution of problems of water supply in the European territory of the country and regions of Central Asia and Kazakhstan.

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REALIZATION OF 'LENIN'S DREAM' FOR IRRIGATION OF CENTRAL ASIA URGED

Tashkent PRAVDA VOSTOKA in Russian 15 May 81 p 3

[Article by Prof B. Lunin: "Lenin and the Irrigation of Central Asia"]

[Text] Where There Is Water, There Is Life

"Land is treasure, water is gold." This laconic saying reflected the experience of many generations of the peoples of Uzbekistan and all of Central Asia. For under local conditions only irrigation was capable of restoring fallow land to life and turning it into fertile areas.

It is natural that the vast irrigation and improvement work carried out since October is put among the biggest economic achievements of the working people of the Soviet East. This work continues on an increasing scale today also, which was strikingly reflected in the decisions of the 26th CPSU Congress. In the years of Soviet power this work has become a nationwide concern and assumed unprecedented proportions and is bearing gener fruit. And this is all the more noteworthy and instructive in that Vladimir Il'ich Lenin was at the source of the struggle for water of the working people of the Soviet East.

At the Source of a Great Undertaking

Showing a profound and comprehensive interest in the historical destiny of the peoples of the colonial outlying districts of the Russian Empire, long before the Octover revolution, Lenin was distinctly aware how difficult their economic situation was under the conditions of the rule of capitalism and feudalism. Nor did he overlook the lamentable state of affairs in the sphere of irrigation. Thus, noting the significance of Central Asia for the development of national cotton growing and other sectors of agricultural production, he observed that here of "159 million desystins of all land, 156 and three-fourths are arid and infertile; only 2 and 1/4 have been artificially irrigated."

Lenin also knew of the existence of the Golodnaya Steppe, which V. I. Masal'skiy, eminent connoisseur of the nature, geography and economy of Central Asia, described in his book "Turkestanskiy kray" [Turkestan] as a waterless "yellowish-gray dead plain scorched by the sun which with its fiery heat and total absence of life entirely justifies its name."

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A book by the well-known economist A. A. Kaufman also attracted Lenin's attention. This, in Lenin's words, "complete liberal, who was inordinately deferential to the bureaucracy of the advocates of serfdom" and an organizer of the so-called Constitutional-Democratic (Cadet), but in practice typically bourgeois-reformist, Party in Russia, knew pretty well, however, the actual state of the economy of Russia and its outlying districts, including Central Asia.

Il'ich paid particular attention to the place where the author had written:
"...the boundless expanses of Turkestan remain underpopulated.... The soil of
many of the 'barren wastes' is the celebrated Central Asian losses, which is distinguished, given sufficient irrigation, by high fertility.... The total area of
land awaiting artificial irrigation is calculated here at many millions of desyatin."

Having read these lines, Lenin wrote: "These many millions of desyatin both in Turkestan and in many other parts of Russia 'await' not only irrigation and all kinds of improvement, they also 'await' the liberation of the Russian farming population from the vestiges of serfdom, the oppression of the latifundia of the gentry and the Black Hundred dictatorship in the state."

Lenin's profound thinking was entirely clear: if all Russia were free, its outlying districts would also be free, and then the real time would have come not only for irrigation but also for everything necessary for the happy life of the working people's masses.

And this time, which had only been dreamed about earlier, came with the victory of the Great October Socialist Revolution. A time of great and long-awaited changes in the life of the peoples of what is now the Soviet East, including the solution of an age-old and most difficult problem--water--for, as Lenin said, it was particularly important under the conditions of the new social system "to uplift farming and animal husbandry at all costs," and therefore "irrigation is needed most of all and will, most of all, recreate the region and revive it, bury the past and strengthen the transition to socialism."

These words of Lenin's were spoken at the dawn of Soviet power. That power of the people which had at that time only just begun to stand on its own feet and was taking the first steps on the primordial ground of socialist transformations.

Right in the first months of Soviet power questions connected with the irrigation of the Golodnaya Steppe, which had a sorry reputation at that time, also came into Lenin's line of sight.

A New Time, New Deeds

The Regulations on the People's Commissariat for Farming and its Land Improvement Department, which had been approved by the RSFSR Council of People's Commissars headed by V. I. Lenin, provided for the activity of administrations for the surveying and compilation of a plan of irrigation of the Golodnaya Steppe and the Zarafshan River valley, the organization of reservoirs in the upper reaches of the Syrdar'ya, the irrigation of Ferganskaya Oblast and the building of irrigation works in the valley of the River Chu.

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In the presence of the prominent power engineer-scientist and old Bol'shevik G. M. Krzhizhanovskiy in 1918 V. I Lenin had a talk with irrigation specialist V. A. Vasil'yev--the compiler of the plan of the irrigation of the Chuyskaya Valley--who had worked in Turkestan prior to the revolution even. Lenin observed to Vasil'yev that Soviet power "will be launching something right now" in the large-scale irrigation plans on the territory of the Turkestanskays ASSR. A big "irrigated cotton program" was being drawn up with Vladimir Il'ich's knowledge. Such top specialists as I. G. Aleksandrov, G. K. Rizenkampf, A. V. Chaplygin and others participated in the preparatory work.

On 24 March 1918 V. I. Lenin chaired a session of the Special Commission with the status of the Council of People's Commissars. Questions of irrigation in Turkestan and its financing were discussed and a draft of the corresponding decree was studied. Following a number of amplifications to it, Lenin signed it on 26 March 1918. A report by the most eminent irrigation engineer G. K. Rizenkampf on a plan of irrigation operations was discussed the very same day at a session of the RSFSR Council of People's Commissars in Lenin's presence. There were new amendments and additions, and it was only after these, on 17 May 1918, that V. I. Lenin signed the "Decree on the Allocation of R50 Million for Irrigation in Turkestan and the Organization of This Work," which achieved the most widespread fame and became a part of history.

Impressed by Lenin's concern for the irrigation of the land of Central Asia, G. K. Rizenkampf, an active participant in the initial operations on the development of the land of the Golodnaya Steppe, wrote: "Thanks to the incomprehension on the part of the highest leaders of state life (of tsarist Russia) of the economic significance of the resuscitation of Turkemistan, we specialists had to expend much energy to persuade people of the urgent necessity...for putting the problem of irrigation on an entirely natural scale.... Following the October Revolution, we encountered in the Soviet Government a lively interest in questions of the irrigation of Turkestan."

Landmark in History

Truly, the very date of Lenin's decree speaks for itself: 17 May 1918. One has to imagine the situation of those days to fully grasp the strength and magnitude of the unshakable conviction of Lenin and the party that, looking into the future, it was necessary to embark right away, without delay, on the practical implementation of the most important tasks of economic building in Central Asia.

And it was a most difficult situation. Orenburg was surrounded by the White Guard bands of the Ataman Dutov. Active forays by the forces of internal and landowner-bourgeois counterrevolution began to multiply anew. The forces of reaction in Central Asia began to stir anew, and abroad certain people were totting up, pencil in hand, how many more days Soviet power would last in Turkestan.

We would add also that we are speaking about a time when even the system of land irrigation which existed in Central Asia and the irrigation equipment based on the use of small-scale sources of irrigation were in a state of decline under the conditions of economic devastation. Many irrigation channels had been destroyed by Basmachi bands, and the throughput of the irrigation network was falling from day to day. The water towers and other of the simplest machine irrigation facilities were in a state of neglect.

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But Lenin and the party looked far ahead, clearly realizing that even the most vigorous measures to restore even the existing irrigation system would be insufficient to advance the business of the irrigation of major land tracts of Central Asia. And even thinking about a considerable and rapid development of cotton growing, grain growing and animal husbandry in the region was impossible without this.

Whence also the memorable Lenin decree of 17 May 1918, which provided for the irrigation of 500,000 desyatins of the Golodnaya Steppe of Samarkandskaya Oblast's Khodzhentskiy District and provision of headworks for an irrigation system covering an area of 40,000 desyatins of the Dal'varzinskaya steppe, the irrigation of 10,000 desyatins of Ferganskaya Oblast's Uch-Kurganskaya Steppe, the organization of a reservoir at the Dupulinskiy Bridge "to free approximately 100,000 desyatins for the cotton plant by way of regulating the flow of the Zeravshan River" and the completion of the construction of irrigation systems in the valley of the Chu River over an area of 94,000 desyatin.

The decree contained instructions concerning the procedure and details of the financing of the planned operations. For implementation of the planned measures the Lenin decree established a Special Administration consisting of a technical director, chief irrigation engineers, specialists in various spheres of technology and economics and others. A staff of the IRTUR of 500 was established. G. K. Rizenkampf was appointed technical director of the administration.

A number of documents which emanated from Lenin and which were connected with the dispatch of IRTUR employees to Turkestan is well known. In them Lenin charged all establishments and officials with "rendering the IRTUR full assistance in all questions arising in connection with the irrigation work"

A number of instructions and orders also emanated from Lenin with categorical directions concerning the removal of any obstacles in the activity of the IRTUR, to which he attached the most serious significance, emphasizing the IRTUR's "tremendous technical value."

On 27 August 1918 there followed a directive of the RSFSR Council of People's Commissars signed by Lenin relieving the employees and workers of the Administration of Irrigation Work in Turkestan of any additional work obligations and preventing the requisitioning and space reduction of the office premises and apartment housing of its employees. Lenin personally charged M. S. Uritskiy, chairman of the Petrograd Cheka, with ensuring the free passage from Petrograd of a train carrying IRTUR property and personnel destined for Turkestan and with organizing its protection and provision with all essentials "in view of the particularly important state significance of the irrigation work in Turkestan."

Shortly after, a train of 30 cars carrying IRTUR property and some of its employees arrived in Turkestan. Among the IRTUR employees were such eminent scientists and specialists as V. F. Bulayevskiy, M. M. Bushuyev, V. A. Vasil'yev, S. P. Trombachev, S. P. Novokreshchenov, R. R. Shreder (subsequently first people's commissar of farming of the Turkestan ASSR) and others.

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In this "Open Directive" of 27 August 1918 Lenin charged them all in the name of all the organs of power to give the utmost assistance to K. A. Popov, who had been appointed assistant chief of operations for irrigation of the Zarafshan Valley, along lines of the Administration of Irrigation Work in Turkestan.

Lenin's Emissaries

As instructed by V. I. Lenin personally, a great deal of work on organization of the IRTUR was performed by his colleague and emin nt Bol'shevik economist Viktor Pavlovich Nogin. Later two sessions of the RSFSR Council of People's Commissars chaired by V. I. Lenin (15 and 22 May 1919) received reports of V. I. Nogin (and also of N. N. Krestinskiy) on the organization of irrigation works in Turkestan and their control system. During his stay in the region Nogin, fully in accordance with Lenin's instructions, constantly stressed that "irrigation is of tremendous significance in Turkestan. More attention and concern than hitherto must be devoted to this matter. It is essential to highlight work on restoring the irrigation installations and make it the subject of the special attention of all Soviet institutions."

Irrigation issues were also in the sphere of the daily attention of the emissaries of the party's Leninist Central Committee sent to work in Central Asia--S. I. Gusev, P. A. Kobozev, V. V. Kuybyshev, G. K. Ordzhonikidze, Ya. E. Rudzutak, M. V. Frunce, Sh. Z. Eliyava and others. Following Lenin's orders, they all saw irrigation as an exceptionally important organic part of the entire set of measures to restore and develop cotton growing, animal husbandry and other sectors of Central Asia's agriculture. Thus Sergey Ivanovich Gusev called for the "preservation and reinforcement of the irrigation network in Turkestan and the restoration of intensive crops, primarily cotton." "The main task at the present time," he said, "is the restoration of agriculture and irrigation."

In the unanimous testimony of Lenin's emissaries in Central Asia, each time it was a question of the region's economic situation, Vladimir Il'ich both in correspondence with them and during personal meetings and talks in Moscow invariably inquired after the state of irrigation, cotton growing and animal husbandry.

"Second Party Program"

As is known, on the initiative of V. I. Lenin and under his leadership the first uniform state plan of the development of the economy of the Soviet republic on the basis of electrification (GOELRO), which Lenin termed the "second party program," was drawn up in 1920.

It is significant that among the scientifically substantiated recommendations on questions of land improvement contained therein, paramount significance was attached to irrigation of the arid land of Central Asia.

The "cotton irrigation program" drawn up by G. K. Rizenkampf and other specialists was made the basis here.

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According to G. M. Krzhishanovskiy, to the question as to the territorial limits of the country within which the extensive development of electrification (and, based thereto, irrigation) should be planned, Lenin said: "As far as Turkestan is concerned,...you can easily include it in the plan now." And a special Turkestan group consisting of such specialists and consultants as I. G. Aleksandrov, V. D. Zhurin, V. V. Aleksandrova-Zaorskaya, G. K. Rizenkampf, R. A. Ferman, A. V. Chaplygin and others was set up to develop electrification and irrigation plans. As G. K. Rizenkampf wrote: "Turkestan is a country of textile raw material with great potential.... For this reason the basis of Turkestan's entire economic program should be an irrigation system which is organically connected with it and which ensues from it," a system without which, he stressed, it will be impossible to very quickly secure the cotton independence of the Country of Soviets.

As the economist V. V. Aleksandrova-Zaorskaya, a participant in the compilation of the GOELRO plan for the Turkestan region, attests, her husband, Ivan Gavrilovich Aleksandrov (an outstanding personality of national hydraulic power and hydraulic engineering), met with Lenin and talked with him about the problem of the electrification of Turkestan, and, furthermore, Vladimir Il'ich closely linked this problem with the accomplishment of the task of the extensive artificial irrigation of the region's waterless land expanses, to which he attached exceptional importance. Ivan Gavrilovich described how Lenin was particularly interested in the possibility of improvement of the land in the valley of the River Chu and the land of the Golodnaya Steppe. "Without irrigation," Lenin said, "we will not appreciably advance the cotton growing and the entire agriculture of Turkestan...."

Nationwide Concern

Together with specialists, local skilled craftsmen and practical irrigation workers from the region's indigenous population and the population itself were enlisted extensively in the implementation of improvement operations, and the further it went, the more irrigation construction became a concern of the entire family of peoples of the Soviet East and a striking manifestation of their strengthening friendship and fraternity.

Lenin continued to follow the implementation of measures to improve and develop the artificial irrigation network of the land of Central Asia with unflagging attention.

The widely known Lenin decree "Restoration of the Cotton Crop in the Turkestan and Azerbaijan SSR's" (2 November 1920) also paid great attention to the implementation of "all priority work to put the irrigation installations in order."

In accordance with Lenin's directives, the party Central Committee, the all-Russian Central Executive Committee Turkestan Commission and the RSFSR Council of People's Commissars and the Turkestanskaya ASSR Council of People's Commissars adopted the decision "Practical Measures in Irrigation" on 28 January 1921. Part of this decision said: "Work on irrigation is deemed to belong to the group of particularly urgent measures."

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At the request of the Russian Communist party (Bol'sheviks) Central Committee Turkestan Bureau and on V. I. Lenin's initiative a further group of experienced irrigation workers which also included those who had worked here earlier was dispatched at the start of 1921. It was headed by a combat colleague of Lenin's, a representative of the illustrious Kadomtsev family of professional revolutionaries, party member since 1901 and active participant in the three revolutions in Russia--Erazm Samuilovich Kadomtsev--who was appointed chief of water resources of the Turkestanskaya ASSR.

The same year three trains were sent to Central Asia with equipment for irrigation construction.

Meeting with delegates, at the 10th party congress (March 1921) Lenin also chatted with the emissaries of the Turkestan party organization, inquiring, in particular, about the state of affairs in land improvement and cotton growing.

On 29 April 1921 V. I. Lenin signed a decree of the Council of Labor and Defense which in anticipation of the possibility of a prolonged dry period in the country charged the People's Commissariat for Farming and its local bodies with adopting urgent measures "to put in order and repair the irrigation installations, watering systems and irrigable areas in Turkestan, the Kirgiz republic, the North Caucasus, the Middle and Lower Volga regions and so forth."

All this was all the more important in that 1921 was accompanied by, among other things, a new complication of matters. The high water level led to the dilapidated irrigation network failing to withstand the increased water pressure and to it breaking down in a number of places. It was necessary to urgently remove the consequences in order to advance the business of irrigation.

The financing of irrigation construction in Central Asia, primarily thanks to state resources and, partially, funds collected by the population itself, also increased constantly.

Thus along Glavkhlopkom lines alone R460,000 in gold equivalent were appropriated for irrigation needs in 1921 and R9 million in 1922.

In November 1922 Lenin instructed G. M. Krzhizhanovskiy, chairman of the RSFSR Gosplan, "to present a report in the Council of Labor and Defense on Turkestan's irrigation system" and same month sent his inquiry to Tashkent to Ya.E. Rudzutak, chairman of the Russian Communist Party (Bol'sheviks) Central Committee Central Asian Bureau, concerning the progress of irrigation work in the region.

The vigorous and persistent measures for the restoration and reinforcement of the irrigation system in Central Asia produced the first results. In 1922 the area of irrigable land in Turkestan had risen to 1.18 million desyatins and in 1923 to 1,587,000 desyatin. By 1923 the Ak-Karadar'inskiy and Dargomskiy water dividers and the Ravat-Khodzhentskiy Works had been rebuilt, the systems of Yuzhniy Khorezm had been reorganized on the Amudar'ya and new irrigation installations had been built at Isfar, Andizhansay and elsewhere. Altogether the irrigated area of Uzbekistan had in 1923-1924 been restored to more than 60 percent of the 1914 level.

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Thus even during Vladimir Il'ich's lifetime the path was marked toward the implementation of increasingly extensive and significant acts in terms of the irrigation of the land of the Soviet East.

"From a Grain of the Revolution"

Also preserved among the hundreds of messages and letters to Vladimir Il'ich from Central Asia are greetings to Lenin (July 1921) on behalf of the workers of Amudar'inskaya Oblast, in which they, as "a grain of the family of social revolution," assured Vladimir Il'ich that "this grain will bear good fruit on irrigated eastern land."

Memorable and evocative words. Abiding by them, we also may say today that the fruit of the magnificent and heroic accomplishments of the peoples of the Soviet East which have led them under the leadership of the Communist Party to the triumph of socialism emerged precisely from such precious grains.

Currently over 900 irrigation systems are operating on the territory of the republic. The length of the irrigation network is in excess of 150,000 kilometers, while the collector-drainage network is 70,000 kilometers long. Vertical drainage has been developed extensively, and more than 1,500 wells are in operation. The total area of machine irrigation now constitutes more than 700,000 hectares. Some 4.5 billion cubic meters of water--such is the net volume of the republic's 19 major reservoirs.

The man-made Karakum River, which bears the name of Lenin and whose waters have turned more than half a million hectares of Turkmen land into arable, stretches more than 1,000 kilometers. In the 10th Five-Year Plan alone more than 63,000 hectares were irrigated in Tajikistan from state capital investments. In Kirgizia the Toktugul' GES on the high-mountain Naryn River (that which the people call the river of friendship) and the enormous reservoir built in the complex with this plant have practically solved the problem of irrigation of the land of the Fergana Valley.

The scale of irrigation-improvement construction broadens and its efficiency grows from 5-year period to 5-year period. In Uzbekistan, for example, over R6 billion were allocated for this purpose and approximately 500,000 hectares of new lands were commissioned in the 10th Five-Year Plan alone. A number of major reservoirs have been built and irrigation channels, collector-drainage networks, pumping stations and other hydraulic works are being constructed in shock manner.

This has been a real exploit of the workers of the Soviet East which they have accomplished under the party's leadership and on the basis of the behests of the great Lenin, who dreamed of converting the desert and semidesert land of Central Asia and Kazakhstan into flourishing and fertile areas of the country. A high and fitting evaluation of this nationwide exploit was made by Comrade L. I. Brezhnev, who emphasized that "the history of our socialist motherland has been and is being made by those who built the Dneproges and Magnitka, who laid the Turksib and Karakum Canal and who turned the Golodnaya Steppe in Uzbekistan into a flourishing oasis."

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Toward New Boundaries

Always and in all things looking ahead in Leninist fashion and not being satisfied with what has been achieved, the party is determining new boundaries of irrigation and all water-resource construction. The "Basic Directions of the USSR's Economic and Social Development for 1981-1985 and for the Period up to 1990," which were approved by the 26th CPSU Congress, envisage the need to ensure the further development of land improvement and to commission through state capital investments 3.4-3.6 million hectares of irrigable and 3.7-3.9 million hectares of drained land and irrigate 26-28 million hectares of pasture in desert, semidesert and highland areas. We have to achieve an increase in the efficiency of the use of irrigable and drained land and a reduction in the time taken to reach planned yield on this land and also a rise in the technical level and quality of water-resource construction and the comprehensive performance of work and land improvement and its agricultural assimilation.

For Uzbekistan it is planned, among other things, to continue assimilation of the Karshinskaya and Dzhizakskaya steppes, commission 450,000-465,000 hectares of irrigable land and irrigate 1.5 million hectares of pasture. In Kirgizia the task is to commission no less than 75,000 hectares of irrigable land, irrigate 500,000 hectares of pasture and complete the construction of the Papanskoye Reservoir. Work will be performed in Tajikistan to irrigate land over an area of 50,000-55,000 hectares and on continuation of the irrigation of the Dangarinskaya steppe. The construction of the Karakum Canal will continue, and 90,000-93,000 hectares of irrigable land have to be commissioned and 6.9 million hectares of pasture have to be irrigated in Turkmenia.

We are confronted in toto with a Lenin-style extensive and Lenin-style bold and daring program of further action by the party and people in the struggle for increasingly new centers of flourishing faraing.

Despite all this, there are still in Uzbekistan, as throughout Central Asia, vast areas of fertile virgin land with a beneficial climate not being fully used owing to a shortage of irrigation water.

As mentioned in this connection at the 20th Uzbek Communist Party Congress, given the availability of water resources, it is possible in our republic to assimilate more than 8 million hectares of new area and obtain therefrom additionally much cotton, grain and other agricultural products.

But here also realization of the ancient, Leninist-inspired dream of the diversion to Central Asia of part of the flow of the mighty rivers of Siberia is drawing close. The "Basic Directions of the USSR's Economic and Social Development for 1981-1985 and for the Period up to 1990," which were approved by the 26th Party Congress, charge us with "continuing scientific and planning studies on diverting part of the waters of the Siberian rivers to Central Asia and Kazakhstan." Wishes were also expressed at the congress for the completion, as far as possible, of preparatory work in the 11th Five-Year Plan even, meaning the initiation of practical measures in this field.

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We are separated by many years from the time of the first measures of the Communist Party and Soviet Government headed by the great Lenin for the restoration and development of the economy of Uzbekistan and all of Central Asia and Kazakhstan, including such a very important and vitally necessary field as irrigation. The business of the artificial irrigation of large-scale land tracts accomplished from 5-year plan to 5-year plan on an increasingly extensive scale and with the use of the latest technology has advanced immeasurably far. Those "many millions of desyatins of land" which the great Lenin had in mind when he said that only the new, socialist system would be capable of accomplishing not only the task of the irrigation of arid land but, the most important thing, the entire set of tasks whose accomplishment was intended to bring the peoples of Central Asia and Kazakhstan freedom, happiness and prosperity have already been restored to life here.

8850

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DZHURABEKOV ON RIVER DIVERSION

Tashkent PRAVDA VOSTOKA in Russian 30 May 81 p 3

[Excerpt of speech by I. Kh. Dzhurabekov, minister of land reclamation and water resources and deputy to the Uzbek SSR Supreme Soviet, delivered at 30 May 81 session of the Uzbek SSR Supreme Soviet]

[Excerpt] However we cannot say that the modern development of our republic's land reclamation is at the proper level. The development of the economy demands improvement in the land reclamation network and expansion of the irrigated land. Much remains to be done in order to use the available water resources rationally and sensibly and to bring the Siberian river waters to Central Asia.

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ECONOMIC ASSESSMENTS

DECLINING LEVEL OF AND PROSPECTS FOR ARAL SEA

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 15 Jan 81 p 4

[Article by T. Abramova, candidate of geographical sciences: "The Aral Needs Help"]

[Text] A unique reservoir of the desert zone, the Aral Sea, has recently claimed the close attention of scientists.

The Aral Sea, one of the world's largest internal bodies of water, has a beneficial effect on the surrounding territories: it moderates their climate, and the waters of the Amudar'ya and the Syrdar'ya Rivers which flow into it irrigate 6 million hectares of land. Cotton, rice, grapes, fruit, citrus fruit and other crops are grown on these lands. And even the Aral Sea itself gave significant catches of fish while in the deltas of the Amudar'ya and Syrdar'ya muscrats were successfully raised.

But since the sixties, when more and more water was removed from the tributaries for agricultural needs, the boundaries of the Aral Sea started to depart noticeably from those depicted on geographical maps. In 20 years, the sea level has declined 7.5 meters the sea has lost 15,000 square kilometers of area and 420 cubic kilometers of water. The salinity of the sea has increased, and actual changes in the chemical composition of the water have taken place. All of this could not but have an effect on the living conditions of valuable species of fish and on the raising of muskrats. And the drying-up of the sea led to the transformation of the surrounding territories into desert lands.

It is true that for now the economic effect of irrigating the land covers the losses in fishing and muskrat raising. This effect will increase in the future since the territory under irrigation is expected to reach 8-9 million hectares. But this creates the danger of a sharply reduced area of the Aral Sea.

Geologists and hydrologists, botanists and soil experts, zoologists and ecologists, economists and paleontologists from various scientific organizations are working of the problem of saving the Aral Sea. Among those many scientific groups, an expedition from Moscow State University in which participated colleagues from our department of geomorphology, visited the Aral.

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We were especially interested in the Late Holocene epoch of the history of the Aral Sea (3,000 - 4,000 years ago) when man's agricultural activity started to have an effect on its level. We studied palinology -- the study of pollen and plant spores found on the sea bottom. Their shell, which has tremendous properties of endurance, guarantees their protection for millions of years. The pollen and spores obtained from the bottom of the sea tell us about the nature of the vegetative covering on the shores of the body of water long ago and about the climactic conditions which prevailed at that time. This helps us to understand the evolutionary process of the Aral Sea and which natural factors, "giving in" to man's activity, led to its present state. We found the following:

At one time the climate was somewhat cooler and damper. The shores held a given type of flora, where in addition to the grasses typical of desert areas, there were also trees. The contemporary climate of the area around the Aral from then on is not conducive to increasing the water levels. In other words, the Aral will not be able to overcome the ongoing process of the decline in the aquatorial mass by itself.

How can we help the Aral Sea, which we simply do not have the right to lose? The most effective measure is to divert part of the flow of the Siberian rivers-of the Ob' and the Irtysh. But this grandiose and very complicated project is possible only in the distant future. What can we do in the near future? Scientists propose several projects. One of them is given below.

V. Bortnik of the State Oceanographic Institute proposes that the preservation of the Aral Sea proceed in two directions. First, the water for irrigation purposes should be strictly regulated, which will decrease the amount wasted. Second, the Aral should be rebuilt to decrease its reflective area, which should decrease the area of water evaporation. Two barriers must be constructed for this purpose: one on the north, isolating the Maloye Sea, and the other flooding the Adzhibash. The remaining river flow will then be directed to this area, and here, in the protected waters, conditions favorable for fishing will be created.

The result is a more economical use of water and a decrease in evaporation. The combination of these two factors should result in a real slowdown in the drying-out rate of the sea and in the protection of the outlying areas.

However, in spite of this, the most important scientific task at this time is to carefully follow the rapidly changing regime of the Aral. We are witnessing a unique experiment in nature, designed by man. Its results are crucially important for the planning of future agricultural measures to be taken in the basins of internal seas and lakes.

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NEW GOALS FOR LAND RECLAMATION WORKERS AND INVOLVEMENT IN RIVER DIVERSION

Moscow GIDROTEKHNIKA I MELIORATSIYA in Russian No 2, Feb 81 pp 2-5

[Lead article: "New Goals for Reclamation Workers and Rural Workers"]

[Excerpts] A significant event was the publication of the draft of the CPSU Central Committee to the 26th Party Congress, "Basic directions for the economic and social development of the USSR for the years 1981-1985 and for the period to 1990" which was published in the press for national discussion.

The draft of the CPSU Central Committee is a document of tremendous political importance which embodies the strategy and tactics of the CPSU on the most important questions of the country's economic, social, and spiritual development with consideration of the specific conditions of the 1980's.

The draft of the CPSU Central Committee envisions the further development of land reclamation. It is planned to put 3.4-3.6 million hectares of irrigated lands and 3.7-3.9 million hectares of drained lands into operation and to flood 26-28 million hectares of pasture in desert, semi-desert, and mountain regions through state capital investments.

The assigned task will achieve a comprehensive increase in the effectiveness of use of irrigated and drained lands and a reduction in the times to attain the planned crop yields on these lands. It is necessary to raise the technical level and quality of hydroeconomic construction, ensure the integrated conduct of work on land reclamation and the land's agricultural development, and accomplish measures to improve the reclamation status of irrigated and drained lands. It is planned to conduct at outstripping rates work on reconstruction of existing reclamation systems and improvement of their dependable water supply, and elimination of salinity and increased soil acidity.

The draft of the CPSU Central Committee envisions the start of preparatory work on diverting a portion of the flow of northern rivers to the basin of the Volga River and continuation of scientific and planning studies on the diversion of the waters of the Siberian rivers to Central Asia and Kazakhstan.

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In the "Basic Directions," special attention is devoted to questions of protecting nature. The task of improving nature conservation, intensifying work on the preservation of agricultural lands, the struggle against their erosion, increasing or accelerating the pace of work on the recultivation of the lands, and ensuring their protection against mud streams, landslides, salinization, swamp formation, flooding, and disruption is posed.

It is planned to speed up the construction of water protection facilities in the basins of the Black, Azov, Baltic, and Caspian Seas and in important industrial regions of the country; to increase the capacities of systems for the return repeated use of water and to develop and introduce at enterprises drainage-free water-utilization systems; and to intensify the protection of water sources against depletion. Work should be continued on the protection and effective use of unique natural complexes and, first of all, Baykal. The creation of automated systems for the control of hydroeconomic complexes in the basins of the most important rivers of the country's European part is envisioned.

The development of reclamation on a country-wide scale is planned in accordance with the accomplishment of the most important task--improvement of the distribution of production forces to raise the effectiveness of social production on the basis of further specialization and proportional development of enterprises in the union republics and the economic regions in a single national-economic complex of the country.

The "Basic Directions" envision the accelerated increase in the economic potential of the eastern regions, the accomplishment of important work on the development of their natural resources, and the development of the fuel-energy and raw-materials bases in Siberia and Kazakhstan. The construction base, housing-public utilities and cultural-domestic services construction, and agriculture should receive intensified development here.

Envisioned in the republics of Central Asia is the more complete utilization of labor and natural resources, production capacities, ensuring a further growth in cotton production, increasing its quality substantially, accelerating the development of animal husbandry and other labor-intensive branches of agriculture, and improving the meliorative state and dependable water supply of irrigated lands.

In the Uzbek SSR, in the Eleventh Five-Year Plan it is planned to ensure the mean annual production of raw cotton in an amount of at least 5.9 million tons, including 400,000-420,000 tons of fine-fibred cotton as well as considerable volumes of grain, vegetables, and other agricultural produce. Continuation of the development of the Karshinskaya and Dzhizakskaya steppes, the putting of 450,000-465,000 hectares of irrigated lands into operation, and the supplying of 1.5 million hectares of pasture with water are envisioned.

In the Kazakh SSR, measures are being planned to ensure the stable production of grain, especially of the durum and strong varieties of wheat, and the further development of animal husbandry. Construction of a network of group water conduits for agricultural purposes will be continued and it is planned to put 400,000-42,000 hectares of irrigated lands into operation and to supply 15 million hectares of pasture with water in desert and semi-desert regions.

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In the Moldavian SSR, it is intended to put 120,000 hectares of irrigated land into operation, in the Kirgiz SSR--42,000-48,000, in the Tadzhik SSR--50,000-55,000, in the Armenian SSR--30,000, and in the Turkmen SSR--90,000-93,000. It is planned to complete the construction of the Papanskoye reservoir and the provision of water for 500,000 hectares of pasture in Kirgizia and to continue the development of the Dangarinskaya steppe in Tadzhikistan, the construction of the Karakum Canal, and the supplying of water to 6.9 million hectares of pasture in Turkmenia.

The document of the Central Committee CPSU attaches special significance to the development of science and technology and it is planned to ensure the development and realization of special-purpose integrated programs for the solution of the most important scientific and technical problems; to reduce substantially the times for the creation and mastery of new equipment and strengthen the interconnection of science and production; and to strengthen the material-technical and test-production base of scientific research and planning-design organizations.

The task of achieving a fundamental improvement of capital construction and increasing the effectiveness of capital investments is being posed. For these purposes, it is envisioned that basic attention will be devoted to ensuring the timely putting of fixed capital and production capacities into operation, concentrating means and resources at the most important construction sites, directing capital investments primarily to the reconstruction and technical reequipping of enterprises and the completion of construction projects begun earlier, reducing construction periods, and improving planning and estimating.

A special section of the draft is devoted to a further improvement in administration and raising the level of management in all links of the economy. During the five-year plan, a further growth in the national well-being and the development of the socialist way of life and the entire system of public relations is to be ensured on the basis of a rise in the economy and raising the effectiveness of socialized production.

Land reclamation workers and workers of the village, just as all Soviet people, inspired by the new horizons which are being opened before them by the draft of the CPSU Central Committee to the 26th CPSU Congress, are ready to apply every effort for the successful accomplishment of the tasks of the Eleventh Five-Year Plan and for the accomplishment of the important tasks of the contemporary state of building Communism.

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SADYKOV, LAPKIN, ANTONOV STRESS AGRICULTURAL BENEFITS

Moscow IZVESTIYA in Russian 4 Feb 81 p 2

[Article by A. Sadykov, president of the Uzbek SSR Academy of Sciences and Hero of Socialist Labor; L. Lapkin, academician of the Uzbek SSR Academy of Sciences and V. Antonov, director of the Central Asian State Institute for the Planning of Irrigation Structures and Rural Electric Power Plants, Tashkent: "Water for the Heat Belt"]

[Text] The plan of the CC CPSU for the 26th congress emphasizes that in the llth Five-Year Plan the stress must be on increasing grain production in the country's fields as a first priority. In the last five-year plan period three years were marked by weather conditions which were unfavorable for agriculture. Nor are we insured for the future against drought in one region of the country and from excessive moisture in another. For this reason it is essential that-in addition to expanding the sown area and increasing the grain yields in zones where grains have traditionally been grown--we create regions which guarantee high yields, based primarily on artificial irrigation in zones which enjoy optimal amounts of heat.

These zones include the northern part of Central Asia, and in particular the regions of the Amudar'ya and Syrdar'ya river basins. In terms of the agricultural output, a hectare of land requiring irrigation here is equal to 8-10 hectares of the dry farm land of the central belt.

Uzbekistan provides an example of the potential which ihe irrigated lands of central Asia possess and of how it can be realized with the increasing level of agricultural technology. We cite a table of yields for basic agricultural crops (in quintals per hectare):

	1960	1970	1980
Cotton	20.3	26.3	33.0
Corn	22.7	27.1	70.0
Rice	18.9	29.3	50.0
Vegetables	96.0	145.0	225.0

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The republic has the opportunities to obtain in the coming years an average per hectare yield of up to 40 quintals of cotton, 90 quintals of corn and 60-70 quintals of rice. Let us cite the example of Bukhara. New canals here have meant an increase in the amount of water provided, and substantial amounts of virgin land have been cultivated for the first time; as a result, the yearly cotton harvests have grown from 400,000 tons to 630,000 tons. In a short period of time the grain harvest has increased three-fold.

As we have mentioned Bukhara, let us note that incomparably large areas of virgin land with high yield potential for soils lie at its very boundaries, the same way that enormous expanses of uncultivated lands lie next to the inhabited regions of the Karakalpak ASSR, Khorezm, Kashkarar'ye, in neighboring Tashauz and Southern Kazakhstan. Only in Uzbekistan can 8 million more hectares be irrigated.

Let us take pencil in hand. According to studies by economists, four million hectares of the total area which could be irrigated can be planted with corn, and the country's largest corn field could be established here with a guaranteed yield of 32-35 million tons of valuable grain per year. From a million hectares of rice there will be a certain six million tons of the "amber grain." Two million hectares planted with cotton would still mean six million of Uzbekistan cotton.

The rapid recovery of the resources invested in the land reclamation in Central Asia has prompted the accelerated development of the spaces of the Dzhizakskaya and Karshinskaya steppes, and this represents a living model for those water management projects which are to be carried out in the Central Asian area of the future.

The main question here is where so much water is to come from. The water resources of Central Asia and Southern Kazakhstan are limited. The total flow of the local rivers is 126.9 cubic kilometers, including 68.1 in the Amudar'ya and 35.6 in the Syrdary'a. Let us note that figure of 35.6 from the Syrdar'ya. Today the demand for water from the river is 45 cubic kilometers. And a third of the river's flow is already used more than once for irrigation purposes as a result of a system of drains and collecting mains from which the water is returned to the river. And this is water which is already mineralized; with each increase in the number of times the water is used, the content of harmful salts grows alarmingly, and in time this may create a threat to the river itself. It may also cause irreversible salinization of the lands.

For this reason the only way to solve the problem of how to accelerate the development of the production forces of Central Asia and Southern Kazakhstan and to create here a major base for the production of food and industrial crops is to divert some of the flow of the Siberian rivers to this area.

Not only the community, party and economic organizations of the republics of Central Asia and Kazakhstan but also representatives of the environmental protection services have expressed themselves in favor of a canal between Siberia and Central Asia because this alone can prevent the shrinking of the Aral Sea and the negative consequences which develop for the entire Aral Sea area.

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A new impetus for this work was provided by the 25th CPSU Congress, which stipulated scientific investigations and planning studies to be carried out with regard to the problem of diverting some of the flow from the Siberian rivers to Central Asia and Kazakhstan. The USSR Ministry of Land Reclamation and Water Management and its Soyuzgiprovodkhoz Institute have worked out the technical and economic documentation of the problem.

Measures which are being carried out in Uzbekistan at present to make rational use of existing water resources and find additional ones make it possible to maintain a fast pace at which new lands are being brought under cultivation and a high rate of agricultural production for various crops, especially cotton, until the arrival of the Siberian water. The whole question, after all, is when will it arrive? If it arrives later than 1990 for the Syrdar'ya basin and later than 1995 for the Amudar'ya basin, the major national economic benefit which can be achieved here will be somewhat delayed, and the development of the region's productive forces will be held back.

The plan of the CC CPSU for the 26th congress reads: "... continue the scientific and planning studies on the diversion of Siberian river water to Central Asia and Kazakhstan." This confirms the exceptional importance of this task. But much has already been done toward this end. And those opportunities which the country's land reclamation specialists have been given force us to take a new look at this problem. For example, the water management organizations of Uzbekistan are today fulfilling construction and installation work worth more than a billion rubles per year. Land reclamation specialists in the Russian Federation, Kazakhstan, Turkmenistan and Tajikistan enjoy substantial opportunities.

The Sredasgiprovodkhlopok [Central Asian State Institute for the Planning of Irrigation Structures and Rural Electric Power Plants] is capable of acting as the general planner for the system in the Aral Sea area. The following are ready to join the work: Sredazgiprotselinstroy, Uzgiprovodkhoz and the Central Asian Scientific-Research Institute for Irrigation. Moscow and other cities have substantial scientific forces for this work.

For this reason the appropriate clause in the CC CPSU plan for the 26th congress should be set out in the following form:

"Continue the scientific work, keeping in mind the development of technical planning for facilities to divert some of the flow from the northern rivers into the basin of the Volga and of the Siberian rivers into Central Asia and Kazakhstan. Begin preparatory work on facilities for the first stage of the diversion."

More powerful pumping stations are required for this construction as well as for the major irrigation regions which are being created in the Dzhizakskaya and Kirshinskaya steppes. For this reason the plan for Basic Directions should be recorded in the following form:

"Provide for the development, manufacture and supply of complete sets of heavyduty pumping, electrotechnical and lifting-transport equipment for pumping stations of large individual capacity."

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38

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IMPROVEMENT OF EXISTING IRRIGATION SYSTEMS ADVOCATED

Tashkent PRAVDA VOSTOKA in Russian 14 Feb 81 p 2

[Article by Kh. Akhmedov, doctor of technical sciences, honored scientific and engineering figure of the Uzbek SSR and head of the Department for the Operation and Automation of Hydraulic Engineering Land Reclamation Systems at the Tashkent Institute of Irrigation and Mechanization of Agriculture: "Raising the Efficiency of Irrigation"]

[Text] "To carry out work at a high tempo in connection with the modernization of existing land reclamation systems, improving the availability of water for them and eliminating salinity and raised acidity levels in soils

(From the CC CPSU plan for the 26th party congress)

The decree of the CC CPSU and the USSR Council of Ministers entitled "Converting Over To the New System of Irrigation for the Purpose of Achieving More Complete Utilization of Irrigated lands and Improving the Mechanization of Agricultural Operations" is recalled. Since that time, a great amount of work has been carried out aimed at enlarging small irrigated tracts and reorganizing the intra-farm irrigation and collector-drainage networks and the thorough levelling off of fields. Work considered to be unprecedented in the history of irrigation has been carried out directed towards raising the availability of water for the irrigated lands, and large reservoirs were built, thus making it possible to control the flow of many rivers which supply water for the canals.

Much was accomplished. However, there were also shortcomings. For example, the efficiency factors for irrigation networks in a number of oblasts were as follows: in Bukharskaya Oblast -- 0.52, in Surkhandar'ye -- 0.57 and in Kashkadar'ye -- 0.45. The average efficiency factor for irrigation systems in the southern oblasts of Uzbekistan was 0.50. If we take into account the water losses caused by percolation on the irrigation fields, by evaporation and by surface run-off, then the efficiency factor for the republic's irrigation systems does not exceed 0.40. Hence the irrigation water losses amount to approximately 60 percent, or 27 billion cubic meters in the basin of the Amudar'ya River and 15 billion cubic meters in the basin of the Syrdar'ya River. Such a quantity of water would be sufficient for irrigating approximately 3 million additional hectares of land.

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The basis for improving the operation of existing irrigation systems is that of modernization and the technical re-equipping of an intra-farm irrigation and collector-drainage network. Thus, unless the dirt canals are replaced by reinforced concrete chutes and a closed (tubular) network, it will be impossible to automate the irrigation operations and difficult to introduce an ASU [automatic control system]. And if the irrigation work is not automated, it will be impossible to raise the efficiency for the irrigation technique to 0.90 or that for the irrigation systems to 0.80, instead of the existing factor of 0.28 - 0.30. This is why modernization is considered to be the number one problem with regard to solving the problems concerned with water availability and improving the operation of irrigation systems.

At the present time, there is no basis for being unduly disturbed over the rebuilding and concreting of inter-rayon (mainline) and inter-farm (intra-rayon) canals, the efficiency factors for which fluctuate at the present time between 0.95 and 0.80. In a majority of the oblasts, their beds have already been covered with a concrete lining, up to 50 percent or more. And then there are the intra-farm canals -- greater attention must be given to these canals during the current five-year plan -- only from 1 to 10 percent are lined. What are the reasons for this? Insufficient attention being given to this problem by the ministries for rural, land reclamation and water management. The scientists and planning institutes have not developed a technology for the modernization of a farm network. In order to raise the efficiency factor for irrigation systems to 0.80 in each oblast by 1990, it should be raised by no less than 4 percent annually. Each year, approximately 3-5 percent of an intra-farm irrigation network should be converted over either to chutes or to a closed network.

I have worked for more than 20 years for the organs of water management. I recall the effect generated by payments for water, with regard to achieving more efficient around-the-clock use of it at the kolkhozes and sovkhozes. After the payments were abolished (caused mainly by the low capability of the kolkhozes which existed at that time), the coefficient of water utilization immediately fell.

Today the kolkhozes and sovkhozes are stronger, and they have at their disposal equipment and cadres of engineers, economists and other specialists. Thus I consider it advisable to include an appropriate item in the CC CPSU plan for the 26th congress concerning the conversion of individual irrigation systems over to the cost accounting system. The introduction of cost accounting and water payments by the kolkhozes and sovkhozes during the Eleventh Five-Year Plan would definitely raise the level of water utilization and ensure more efficient use of the water resources. This measure could stimulate the modernization of farm irrigation systems. Indeed, each farm could obtain additional income by increasing the KZI coefficient of land utilization] from 10 to 20 percent. This would be especially important in those areas where free lands were developed long ago.

I propose that the following supplements be added to the CC CPSU plan: "In 1982, to convert 25 percent of the irrigation systems over to cost accounting, with the introduction of payments for water and to complete the conversion of all irrigation systems over to cost accounting by the end of the five-year plan; commencing in 1982, begin the complex rebuilding of the irrigation network, taking into account the completion of modernization work on the irrigation systems at all kolkhozes and Sovkhozes prior to 1990.

40

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ACADEMICIAN CITES PROBLEMS OF CASPIAN, ARAL, AZOV SEAS

LD230941 Moscow PRAVDA in Russian 16 Feb 81 p 6

[Academician Ye. Fedorov article: "Protecting Nature for People"]

[Excerpt] A serious problem is the destiny of the three seas—the Caspian, the Aral and the Azov Seas.

The level of the Caspian Sea is falling. True, the fact that the Kara-Bogaz-Gol, from which 5-6 cubic kilometers of water evaporated annually, has been cut off from the sea does create a temporary reserve for water consumption in the Caspian basin. Nonetheless the further diversion of water from the Volga for irrigation and other needs must be linked with the diversion of part of the flow of the northern rivers of the USSR's European territory into the Volga.

The significant reduction in the flow of the Syrdar'ya and Amudar'ya Rivers in connection with the irrigation of lands in Uzbekistan, Kazakhstan and Turkmenia is causing a rapid fall in the level of the Aral Sea. At the same time possibilities exist for countering this process, to which end appropriate research and planning work must be carried out in the immediate future.

The use of part of the flow of the Kuban River for irrigation has led to a significant reduction in the inflow of fresh water to the Azov Sea, which is increasing its salt content and causing undesirable ecological consequences leading to a fall in the stock of valuable fish. There are a number of proposals for optimizing the ecosystem in the Azov Sea (building a dam in the Kerchenskiy Strait and other proposals). From our viewpoint measures to resolve this problem too must be implemented in the near future.

In connection with what has been said, it would be expedient to incorporate in the CPSU Central Committee's draft for the 26th CPSU Congress the following proposition: "To consider it necessary, in planning new enterprises, to give preference to closed, waste-free techniques. To complete the necessary research and design developments and commence work on the restructuring of the Aral Sea and the optimization of the ecosystem in the Azov Sea."

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DIVERSION OF SIBERIA'S RIVERS SEEN AS 'OPTIMUM SOLUTION'

Tashkent PRAVDA VOSTOKA in Russian 20 Feb 81 p 3

[Article by E. Rakhimov, candidate of economic sciences, and L. Kamalov, candidate of geographic sciences and head of sectors for a Council on the Study of the Republic's Productive Forces of the Uzbek SSR Academy of Sciences: "Optimum Solution."]

[Text] Uzbekistan, similar to other union republics in the region, has rich opportunities at its disposal for further and more rapid economic and social development. This includes favorable natural-climatic conditions, vast areas of fertile land that are suitable for irrigation and a high pupulation density, the size of which is increasing with each passing year.

The one area in which nature dealt unfairly with our kray is water. Computations have shown that if the present rates for land development are maintained, the water resources of the Syrdar'ya and Amudar'ya rivers will be exhausted during the next 5-10 years.

What then will happen to the 8-10 million hectares of empty land which exist in Uzbekistan along? How much water will be required to restore them to life?

According to studies carried out by the Council for the Study of the Republic's Productive Forces of the Academy of Sciences for the Uzbek SSR, one cubic meter of irrigation water will make it possible to develop 70,000 hectares of empty land and this will provide the national economy with a worthy increase amounting to approximately 300 million rubles.

A computation reveals that during the next few years the region must be provided with at least 25-30 additional cubic kilometers of irrigation water annually.

But where will such water come from?

The scientists, specialists and production workers, following extensive and laborious studies and a comparison of many variants, have drawn the conclusion that the only solution for the problem consists of rapidly diverting part of the flow of Siberian rivers into Central Asia and Kazakhstan.

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It is obvious that a portion of the water required can be obtained by means of internal reserves, by optimizing the regimes for water utilization in the region. But only a portion. And by no means in the amount mentioned by Doctor of Technical Sciences Kh. Akhmedov in his article entitled "Raising the Efficiency of Irrigation," published on 14 February of this year. By no means wishing to negate the importance of his arguments, particularly the need for raising the efficiency of irrigation networks, we believe that the key to solving this problem lies in diverting part of the flow of Siberian rivers and only by this means. No other internal water resources will make it possible to develop irrigation farming in the region, at the rates called for in future planning.

The delivery to Central Asia and Kazakhstan of Siberian water will make it possible to increase considerably not only the production of raw cotton but also other very important types of farming and animal husbandry products, thus completely solving the food program outlined during the October (1980) Plenum of the CC CPSU.

At the present time, the Soyuzgiprovodkhoz Institute of the USSR Ministry of Land Reclamation and Water Resources has completed its work on a TEO [technical and economic substantiation] for the first phase of the diversion, with more than 150 scientific-research and planning organizations throughout the country also having participated in this work. The TEO has presently been presented for review by a state committee of experts of USSR Gosplan.

In view of the great national economic importance attached to accelerating the diversion of these waters, we propose that the paragraph in the Basic Directions which touches upon this problem be reworded as follows:

"During the Eleventh Five-Year Plan, to complete the scientific and planning studies associated with diverting the waters of the Siberian rivers into Central Asia and Kazakhstan and to commence carrying out the preparatory work for the priority objectives of the diversion."

7026

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RIVER REVERSAL

Moscow NAUKA I RELIGIYA in Russian No 3, Mar 81 pp 20-22

[Excerpts from article by S. Gushchev: "Renewed Land"]

[Excerpts] A river flows uphill. Talimardzhan is located on a high plateau. The Amudar'ya River which supplies this area with water is far away--over a hundred kilometers. The water had to be pumped uphill, lifted 132 meters. It is not difficult to picture a rushing hundred-kilometer-long river with a series of six hydroelectric stations (HES), where the water spins the turbines and generates electric energy. It is more difficult to picture, and still more difficult to construct what is essentially the direct opposite: the same river flowing in reverse. In place of the six HES there are six powerful pumping stations, requiring a huge amount of energy, nearly a thousandth of all the electric energy generated in the country. And this is only the initial phase! The energy comes over highvoltage electric transmission lines, traveling hundreds of kilometers from the Central Asian power ring, this unique "mutual assistance bank" of four republics. Tajikistan with its famous Nurek HES on the Vakhsh River is the largest investor in this "bank". The Karshi "virgin soil" region does not intend to remain a debtor: the foundation is already being laid for the 3.2 million kilowatt Talimardzhan GRES [State Regional Electric Powerplant]. This GRES will operate on the extensive supplies of local natural gas.

But at the moment, taking energy "on loan," the pumps are forcing the water into the Talimardzhan Sea--the largest of all the water reservoirs of the republic. In order to create this sea it was necessary to surround the dry, dead valley with a 28-meter-high dam. We drove a full 12 kilometers along the dam. Two billion cubic meters of life-giving water will be stored behind this impregnable rampart. Water will flow by on gravity from this sea over the entire Karshi steppe.

But gravity flow does not mean random flow, wherever or whenever the water wishes: intense construction is going on and paths for the water are being forged. The first phase of the irrigation network will cover nearly seven thousand kilometers. The subdrains will cover about eight thousand kilometers. A tremendous amount of work and funds and much inventiveness and talent are being invested in all this. Khamid Faziyevich Gaybullayev, deputy chairman of the Kashkadar'inskaya Oblast Ispolkom, says: "The canal from the Amudar'ya was constructed in 1973. In 1986 the net income from these lands will exceed the sum of the capital

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investments. And in another ten years the region will be fully developed. Remember the saga of Golodnaya Steppe? There 160,000 hectares were developed over a period of twenty years. Here the same area has been put into operation in only eight years. The growth rates are now twice those of the previous period, and they will soon be four times as high. There is nothing surprising in this-much experience has been acquired and powerful technology is at hand."

<u>Possibilities and prospects</u>. As we have mentioned, the pumping station is simply a HES operating in reverse. Each pump is driven by a 12,500-kW electric motor and pumps up to 40 cubic meters of water a second. Within two or three years motors of twice this power will appear at the installations of the second phase, and then each pump will supply over 70 cubic meters of water a second.

Ivnn Kondrat'evich Dudenko, operations director of the Karshi Main Canal and Pumping Stations, says: "The fact that increase of the power of the individual pumping units is economically advantageous is an obvious truism. But this is not all, this increase of the unit power corresponds to our goals, our future plans, both near-term and long-term. The second phase of the project will use 24-kW engines, but at the Elektrotyazhmash Plant in the Urals thought is already being given to 99-kW engines. Each such machine can pump up to 200 cubic meters a second. It won't be long until we will be needing such engines: plans are to divert part of the flow of the Siberian rivers into Central Asia, and we must prepare for this as soon as possible. Therefore we are looking at the Karshi system not simply as an enterprise but rather as a sort of research test facility, where all the new technical ideas will be tried out."

Dudenko continues: "At the present time a conventional telemechanics system is helping to coordinate the operation of the entire series of six pumping stations, but with the introduction into operation of the second phase this system will not be adequate. A more reliable and effective control system will be required. A computer is already under development in Tashkent for this purpose. When the ASU [Automatic Control System] goes into operation it will be possible to establish instantaneously the optimal operating regimes for all the stations. This experience will later be used for the huge stations which will pump water from the Irtysh into Uzbekistan..."

On the return trip we stopped at the 28-meter Talimardzhan Sea dam. Water poured through the six broad pipes in the dam with a deafening roar, and somewhere off in the distance (beyond the horizon) the shores of the steppe stretched along the edge of the water. A breeze was driving white-sailed yachts over the waves. Silvery fish, a good helf meter long, romping like dolphins, jumped out of the swirling waters. The reservoir is still being filled, but the fish already feel right at home.

Per aspera ad astra. "Through difficulties to the stars!" Here this ancient aphorism is taken nearly literally. The working people of the republic are truly raising the thorny Karshi steppe to stellar heights, to the heights of a happy life, full of glorious exploits and great achievements.

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9576

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45

PROPOSED RIVER DIVERSION CITED AS ECONOMIC BENEFIT FOR NATIONALITIES

LD251709 Moscow NOVOYE VREMYA in Russian No 11, 13 Mar 81 p 21

["Conversation With the Reader" by Albert Pin, member of the NOVOYE VREMYA Editorial Board]

[Excerpt] The Soviet Union's national economy is an organic amalgamation [obedineniye] of all the union republics' economies, a unified economic organism that has taken shape on the basis of the common economic aims and interests of all nations and nationalities. I will cite just one fact—in my view a typical one. At the Soviet communists' supreme forum—the 26th CPSU Congress—the delegates proposed that preparations for the majestic task of diverting part of the flow of Siberian rivers to Kazakhstan and Central Asia be completed as early as during the 5-year period just begun. This will make it possible to irrigate millions more hectares of land and to increase the development rate of the whole country's agrarian sector. Those are the kind of concerns we have at the moment, Mr Michaud.

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CENTRAL ASIAN DESERT IRRIGATION PROJECTS

East Berlin BAUERN-ECHO in German 14-15 Mar 81 p 7

[Text] Water gives new life. Almost 15 percent of the world's population live in arid zones. The spread of the desert today is a worldwide problem. Each year, between 5 and 7 million hectares of soil are turned into desert. With the help of the Karakum Canal and other tremendous irrigation systems, the Soviet Union has already been able to reawaken millions of hectares of desert land to new life. "The 1 million Puds of grain we are getting from Kazakhstan are becoming a habit," said Leonid Il'ich Brezhnev at the 26th CPSU Congress. How much greater could that figure be if the far-flung steppes, with their fertile soils, were to contain large quantities of additional water? "The expansion of the irrigation systems in Central Asia" according to the secretary-general of the CPSU Central Committee, is one of the development problems that is ready for solution. But where is all that water for those vast areas supposed to come from? Soviet society is in a position to solve these problems which are so important to mankind, and that is the idea that determined the content of several discussion contributions at the 26th CPSU Congress. Mukhamednazar Gapurov, first secretary, Central Committee, Communist Party of Turkmenistan, like the other representatives of Central Asia, came out in favor of a positive decision on the question of diverting a part of the water volumes from the Siberian Rivers into that part of the Soviet Union. Dinmukhamed Kunayev, first secretary, Central Committee, Kazakhstan CP, came out in favor of preparatory work for this mighty undertaking. The daring dreams of the peasants in these regions would thus come true. The family of socialist peoples and all humanity would become tremendously richer. But neither the transformation of the desert, not the diversion of the rivers from the north to the south are easy. The two articles below were written by experts from the Desert Research Institute of the Turkmen Academy of Sciences and the Geography Institute, Academy of Sciences USSR, and show this very clearly. They were translated by Dr. W. Roemer, Halle, made available to BAUERN-ECHO.

47

How Can the Desert Be Made to Bloom?

The deserts of the USSR form a broad belt extending for an area of 1,200 kilometers from north to south and 2,500 kilometers from west to east. They stretch from the Apsheron Peninsula on the Caspian Sea and the Volga delta all the way to the eastern edges of the Kyzylkum, Muyunkum, and Sary-Ishikotrau deserts. The USSR has a total of more than 300 million hectares of desert and semidesert, almost one-sixth of its entire territory.

The summer temperatures in the Central Asian desert rise to 40-50° C and more. Machinery and objects made of metal cannot be touched because they are heated up to 75-80° C. During the summer it is also difficult to work in the factories, especially in those where production requires high temperature. The desert heat is often accompanied by tornadoes and sandstorms. The hot and dry winds stifle all life, cause the leaves of plants to dry up, damage crops, fruits, and pastureland. In the winter, there is severe frost and heavy snowfall sometimes lasting for 2 months. But the desert supplies food for the local inhabitants and the desert is generous, in its own way.

The irrigated share in the border areas of the desert comes to about 3 percent of their total surface. This extremely fertile land yields one-third of the Soviet fiber output (cotton, hemp), more than two-thirds of the raw silk, almost one-fifth of the vegetable oil (including cottonseed oil) and many fresh and dried fruits as well as tropical fruits. Animal husbandry is adapted to the desert and is the second most important branch of agriculture. Just two or three men can herd 1,000 sheep or goats which can feed the whole year through on the fodder they find underfoot. The much-praised Karakul sheep can be kept only under desert conditions. The USSR produces half of the world's Karakul skins. The country also gets 50 percent of its wool from the desert.

No matter what problems man is confronted with in the desert (technical, industrial, and agricultural problems), they can be solved only if he has enough water available. The main source is local surface and underground water. The deserts in Central Asia and Kazakhstan contain enough rainwater for the animal herds of the nomads, small settlements, work stations along gas and other transport pipelines, as well as drilling teams.

Experts from the Desert Research Institute in Turkmenistan are looking for ways to reduce the evaporation of water, for example, by applying thin fllms consisting of certain substances on top of the water surface. Smaller water basins, screened against the wind, can be protected against evaporation for one year with this kind of film. The efforts naturally are aimed at protecting the big natural and artificial lakes and basins.

In the most recent past, we have also begun to make more use of underground water. Entire lakes of underground water were discovered near the desert and they are better investigated here than in other parts of the USSR. A large part of that underground water is not suitable for supply to the cities and villages because of its high salt content. But when the salt concentration is no more than

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5-6 grams per liter, it can be used for watering animals and irrigating pastureland. Experiments conducted on Kyzyl-Su Peninsula (Bay of Krasnovodsk) for irrigation revealed that even the water of the Caspian Sea is suitable for irrigation with 13 grams of salt per liter.

Sea water treatment plants have for a long time been operating in the cities of Shevchenko and Krasnovodsk and supply huge industrial complexes. Small distillation plants, with a daily output of as much as 25 cubic meters, are being built in more remote desert regions. Other desalination methods, such as osmosis and electrodialysis, are also being used.

Presently, more than 6 million hectares are being irrigated in Central Asia. The once fantastic idea of diverting Siberian Rivers to Central Asia and Kazakhstan is now beginning to take on more realistic features. There is no doubt that Central Asia needs Siberian water. A portion would be used for the irrigation of the virgin soil of Kazakhstan (20-30 million hectares), but most of the water would be used for irrigation of the desert in the Aral basin.

Moving South

Diverting Water From Siberian Rivers to the South

The serious water shortage in the southern part of the USSR makes it necessary to divert a portion of the Siberian rivers, which flow north, to the south during the next several decades. Before such a gigantic undertaking can be carried out, it is important to consider a group of numerous environmental factors.

The idea of diverting the northward-flowing rivers into the dry south has been discussed for a long time. One of the main problems is connected with the fact that there is not enough water in the warm, southern regions, where irrigation in agriculture is most effective.

There are 60 million people living right along the main rivers of Central Asia, in the south of the RSFSR, in the Ukraine and in Kazakhstan. They and industry, which has developed in that region, likewise need water. There are two ways to increase the water resources. First of all, it would be possible to use storage basins for river flow rate regulation in order to increase the water level in them during periods of low water. Second, the territorial redistribution effort could bring water from the big rivers, that flow into the Arctic Ocean, to the dry regions of the south. This leads to the necessary problem of creating a cascade of storage basins along the northern rivers. The water would then be pumped from the lower basins into the higher basins and so to speak flow upstream. The water will then move south, either through the Volga and Kama Rivers in the European part of the USSR, or in extremely long canals to be specially built in Siberia.

The partial diversion of river water to the south is being discussed in some preliminary projects. For the northwestern section of the European part of the USSR, there is a plan to divert water from the Sukhona and Onega Rivers and from Lake Onega into the Rybinsk reservoir and from the Pechora and Vychegda into the Kama.

49

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Regarding western Siberia, there is a proposal to take water from the Ob'. An additional supply of water could come from the Yenisey. It has been proposed to take water from the Tobol and the Ob' prior to its confluence with the Irtysh. A canal from the Tobolsk reservoir near Kurgan would run across the Turgay depression and would end east of the Aral Sea, between the Syrdar'ya and the Amudar'ya. The capacity of this 2,000 kilometer long canal would correspond to that of the Dnepr.

Another idea is to conduct water from the Ob' over the Urals to the Pechora and then on to the Volga and Kama. The water volume would be enough for the irrigation requirements in the southern European territory and in western Kazakhstan and to maintain the water level in the Caspian Sea.

These various projects are the result of an enormous research effort in which the alternate routes of bringing water to the south were weighed. It is important to stress that those alternatives have already been discarded which obviously could have a seriously negative effect on the environment. For example, the planners were trying to keep the surface of the man-made lakes as small as possible in order to minimize the flooding of land. While the original project for the diversion of the Pechora River's water into the Kama called for a reservoir lake covering an area of 15,000 square kilometers, its size in the last version amounts to only one-third of that. But the geographers must analyze in greater depth the as yet not obvious effects that might derive from the alteration of the river courses regarding the surrounding environment. They must minimize the negative effects and optimize the advantages to the environment if the projects are to be carried out.

One of the most difficult questions arising in the project for the diversion of water to the south, was the water volume needed by the south. The water volume brought in from the north will depend on the utilization of local water resources. The potential of the water volumes annually developing in Central Asian mountains was figured at 125 cubic kilometers. But it is impossible to use the entire quantity on account of the annual fluctuations in the water levels of the rivers and the considerable losses. About half of the quantity is used for irrigation. During the dry years of 1974-1975, there was not enough water for irrigation. A system of reservoir dams for irrigation purposes in the Central Asian mountains could at least partly help make up for the water shortage during dry years.

In computing the water quantity to be diverted to the south it is necessary to think of the large water volume which would have to be supplied to the Aral Sea and the Caspian Sea. It is quite clear that it will not be possible to preserve these lakes in their original form. Too much has already changed in them, especially their water level and an entire complex of factors. These changes must also be considered. It will only be possible to preserve both lakes if their size is reduced and that would reduce the water losses due to evaporation. In other words, we are talking about an artificial recovery of the natural mechanism which in the past has maintained the level and the salt content of the Caspian Sea.

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The territorial redistribution of water resources is closely tied to the future of the western Siberian depression, especially the swampy regions. They take up an area of about 800,000 square kilometers and each year spread by about another 100 square kilometers. This situation cannot go on. Western Siberian oil and gas are presently attracting much attention and in this way the first steps to tackle this swampy terrain are being taken. Other swampy regions are being recultivated also for agricultural and forestry utilization. Because many of these swampy regions get their water from rivers that spill beyond their banks, it should be possible to use this surplus water from small rivers as a part of the water diverted to the south.

The draining of the swamps will very probably reduce evaporation which reaches a maximum at this time in the wet regions of western Siberia. That could also increase the water resources earmarked for diversion to the south or it could at least compensate for the water taken out of the Ob' and the Irtysh.

Taking water out of the big rivers--Ob' and Irtysh--will also lower their flooding to a certain extent and will thus help reduce the swampy surface areas. Regions into which the water is brought must be inspected because their water balance will also change.

Another effect, which must likewise be investigated, is the change in icing conditions in the north. It is unlikely that the ice cover will extend to the mouth of the Pechora and the Ob' and the adjoining Barents and Kara Seas because the reduced supply of river water will help reduce icing.

Steppe Transformed

Melons Grow Today Where There Used To Be Sand Dunes

So far, 30 million hectares of previously infertile desert and swampland have been turned into blooming farmland in the Soviet Union. Just a short time ago, during the second half of January, the first section of the seventh pumping station in the Karshi main canal in Uzbekistan was placed in operation. A start has been made thus toward pumping water from the Amudar'ya into the storage area of the Talimardzhan sam. From here, tens of thousands of hectares of cottonland are to be irrigated in the new cotton state farms of the Karshi Steppe.

In the Tenth Five-Year Plan (1976-1980), more than R1 billion were invested each year in the water industry buildup in Uzbekistan and 500,000 hectares of new irrigation area were prepared. The transformed Golodnaya Steppe became a proud achievement for the Uzbek SSR and the USSR. The need for their irrigation had already been mentioned in a decree signed by Lenin.

Today, this former desert region supplies more cotton than was produced in the entire prerevolutionary Turkestan. Today, 50 newly created state farms are being operated in this region of the former Golodnaya Steppe. Where there used to be sand dunes, cotton grows today, canteloupe and watermelow ripen today and vineyards spread out. The soils of the Karshi and Dzhizak steppes are now being explored in a complex fashion on the basis of these experiences.

5058

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IMPORTANCE OF RIVER DIVERSION INSOLUTION OF WATER SUPPLY PROBLEMS

Moscow GIDROTEKHNIKA I MELIORATSIYA in Russian No 4 April 81 pp 6-10

[Article by Deputy Minister for Reclamation and Water Management O. B. Kanatov: "Role and Tasks of User Organizations in Increasing Effectiveness of Reclaimed Lands"]

[Excerpt] Economizing on Water

The broad development of irrigation in the country into a primary status has advanced the problem of supplying enterprises with water. Irrigated farming now requires more than half of all water taken from water sources for the needs of the national economy.

Of the overall volume of water intake of $340~\rm{km}^3$ about $200~\rm{km}^3$ is used for irrigation, and what is more, about 80% of this water is irretrievable. An insufficiency of water resources will be experienced in the near future in several river basins in the southern zone of the country.

Questions of supplementing the water resources of these regions by means of diversion of water from other regions of the country with more dependable water supplies are being studied and resolved: The flow of the Danube River into Moldavia and the southern Ukraine, the flow of the Volga into the Azov Basin, part of the flow of the northern rivers into the Volga, and of the Siberian rivers into Kazakhstan and Central Asia. However carrying out these measures demands large capital investments and a significant amount of time. In this connection questions of rational and economic use of water take on a special significance, especially in the republics of Central Asia and Kazakhstan.

It should be frankly said that in practice that questions of economizing on water are at the present time being dealt with poorly. Thus, for example, the water taken for irrigation from the Syrdar'ya River during the vegetation period last year amounted to $25~\rm km^3$, and taking into account the fall and winter water requirements it is $31~\rm km^3$, which exceeds the total flow of the Syrdar'ya River. The excess in the amount of water taken over the volume of existing water resources under conditions of full streamflow regulation inevitably leads to a water shortage in dry years. In the future the expansion of irrigated lands in the Syrdar'ya River Basin should be fully coordinated with plans for the complex restructuring of existing systems, and chiefly with carrying through measures for strict economizing on water.

52

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Analysis of utilization of water resources of another Central Asian river -- the Amudar'ya -- shows that here too it is necessary to do work on economizing on water. In the Karakalpak ASSR and the Tajik SSR, for example, the actual irrigation rates are half again higher than the fixed rates.

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SOCIO-ECONOMIC PROBLEMS OF TERRITORIAL REDISTRIBUTION OF WATER RESOURCES

Moscow EKONOMIKA SEL'SKOGO KHOZYAYSTVA in Russian No 5, May 81 pp 60-64

[Article by Prof Kuz'ma Ivanovich Lapkin, doctor of economic sciences, academic secretary of the Department of Economic Sciences of UzSSR Academy of Sciences and Eduard Davlyatovich, candidate of economic sciences, head of the Council for the Study of Productive Forces of the UzSSR Academy of Sciences]

[Text] The Communist Party and the Soviet government attach much importance to the intensive development of the productive forces of the country's eastern regions, including the republics of Central Asia. The social and economic changes in the republics of Central Asia, attained on the basis of Leninist national policy, have created favorable conditions for the rapid development of productive forces and the improvement of production relations.

In Uzbek SSR, there was formed and widely developed an agroindustrial complex (APK) with cotton growing as its core. Fifty-six percent of the gross social product and 77 percent of the national income of the republic constitute the share of the agroindustrial complex. The material-technical base of the agroindustrial complex is being improved.

But for the solution of the big social and economic tasks set by the 26th party congress, the attained level of development of the republic's productive forces is inadequate.

The republic possesses favorable natural-climatic conditions for the production of big yields of cotton, vegetables, fruits and a large amount of land suitable for irrigation. It also possesses the main thing--people provided with advanced equipment. But intensive operation of Uzbekistan's agriculture is impossible without artificial irrigation of land. Given the conditions of the republic with the existing level of intensiveness and specialization of farms, the production output cost on irrigated lands is greater than on nonirrigated lands by a factor of 10-12.

Under the conditions of irrigation farming, irrigated lands serve as the chief means of production. Water supplied to the place of use with the aid of irrigation systems becomes the most important condition of raising the economic fertility of the soil. Consequently in irrigation farming, land and water constitute one single whole. K. Marx indicated this unity when he wrote that "... land also implies water..." (K. Marx and F. Engels, "Sochineniya [Works], Vol 25, Part II, p 164).

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Water is distributed extremely unevenly over the territory of our country. Consumption of water is particularly restricted in the south of the country, particularly in Uzbekistan. Calculations of specialists show that whereas the per-capita average for the USSR is about 18,000 cubic meters of water flow per year, that in the south of the country is only 300-1,500 cubic meters or smaller by a factor of 15-20.

Problems of water supply have become particularly acute in recent years in connection with the need of boosting qualitative requirements in regard to the rational use of irrigated land and irrigation water. The opinion has been given that significant resources of their own water supply exist in the republics of Central Asia. The data behind this assertion have not been adequately substantiated.

The total annual flow for the basin of the Aral Sea has been set at 127.5 km 3 . In recent years (1970-1978), the employment of water for national-economic needs, with account being taken of the repeated use of a part of returning water and water losses in beds of rivers and at water reservoirs, on the average amounted for the basin to 107 km 3 of which more than 80 percent was used in agriculture for irrigation. A leading place in the use of the water resources of the basin of Aral sea belongs to the UzSSR. According to the data fo the UzSSR Ministry of Land Reclamation and Water Resources, 61 km 3 (57 percent of the total withdrawal of water from the basin), including 53.3 km 3 for agricultural needs of which 51 km 3 were for the irrigation of land, went to farms in 1978.

The water resources of the Aral Sea are close to exhaustion, and dry years create significant difficulties in providing agriculture with water with all the negative consequences stemming from this. Even at the present time, water resources in a number of rayons of the UzSSR are a limiting factor in the development of especially agriculture. According to the data of a forecast for the development of the agricultural sectors of Uzbekistan, shortage of water resources even in the immediate future will amount to $15\text{-}20~\mathrm{km}^3$.

It should be specially emphasized that the water deficit may be partially reduced through more rational utilization of existing water resources by means of seasonal and repeated regulation over the years of flow of rivers by means of the construction of water reservoirs; boosting the efficiency of irrigation systems; improving water use on the basis of refined hydromodular norms and the introduction of automation of water distribution and mechanization of irrigation: more economic employment of water in different sectors of industry through placement of low-water intensive production operations and the intro uction of water recycling technology.

As we know, the construction of water reservoirs does not create new water resources; their role is tremendous in regulating the reserves of water resources by years and seasons. The most significant water reservoirs in the basin of the Aral Sea are close to the end of the Toktogul'skoye at Naryn (Kirghizia), Nurekskoye on the Vakhsha, the under-construction Rogunskoye (Tajikistan), Tyuyamuyunskoye on the Amudar'ya, the Andizhanskoye on the KaraJar'ya (Uzbekistan) and several others.

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The guaranteed regulated flow in the basin of the Aral Sea has been set at $105~\rm km^3$. The possibility of filling up new large water reservoirs to projected capacity is problematical due to the shortage of water, which is practically completely utilized for irrigation in the summer and in the nonvegetation period for leaching of saline lands. In Uzbekistan alone, $10\text{-}12~\rm km^3$ of water are expended in leaching operations.

Hence it follows that until withdrawal of water for leaching of land is significantly reduced, it is impossible to hope for normal filling of water reservoirs. Taking into account what has been said, it must be assumed that until full, comprehensive reorganization of all systems and the diversion of part of the flow of Siberian rivers, even completely built water reservoirs, especially those regulated over the years, will operate with reduced supply, which will be reflected in the size of guaranteed flow for irrigation needs, increasing water shortage during dry years to 40-50 percent.

The level of technical equipment of interfarm and particularly intrafarm irrigation networks is at present low. According to the data of the UzSSR Ministry of Land Reclamation and Water Resources, as of 1 January 1979 only 21.3 percent of interfarm canals were lined with concrete, while the efficiency of the interfarm network was 0.82. Only 5.3 percent of intrafram systems were lined with concrete and their efficiency was about 0.70.

Analysis of the effectiveness of the work done in connection with the reconstruction of the intrafarm irrigation network in the republic has been hindered by the fact that this work is being carried out disjointedly, not comprehensively, and fails to encompass all the elements of the systems; the actual outlays on their reconstruction are significantly below the norm.

The volume and tempo of reconstruction of intrafarm systems are being restrained primarily by all the organizational complexity of the work being done on reconstruction. This work is being done on systems at existing farms with difficult plan targets for the procurement of agricultural products, and it can be performed on a broad scale only through removal of reclamation fields from agricultural work rotation.

The most radical solution of the problem of reconstruction of the intrafarm system is possible under conditions of performance of the work within the complex, with the development of intrafarm resources and the expansion of irrigated land on farms. But in such a case the volume of capital investment used increases significantly. A factor retarding the tempo of putting intrafarm systems in order is the lack of specializ d construction organizations engaged in reconstruction and special departmental control within the republic's Ministry of Land Reclamation and Water Resources.

It is necessary to take the following into consideration when calculating the volume of work relating to the reconstruction of irrigation systems, capital investment, long-term efficiency and possible savings of water resources.

Boosting the efficiency of systems through counterfiltration measures simultaneously results in reducing the quantity of returned water, including that used a second time for irrigation. The positive side of carrying out antifiltration measures consists in the qualitative improvement of irrigation water supplied for irrigation through the reduction of the volume of repeatedly used mineralized return water.

Moreover, in the last 10-15 years there have been put into operation more than 700,000 hectares of new irrigated land on the basis of technically perfected plans. Irrigation systems embracing an area of 2,500,000 hectares of old irrigated lands are to undergo reconstruction. The systems to be reconstructed are in need of varied complex improvements. The work needed for this in terms of composition, labor intensiveness and therefore length of time and expenditures will come close to new construction and possibly exceed it, inasmuch as construction under conditions of operating systems will be fraught with many complications that are absent in the building of new ones.

Special attention should be given to the creation of a compensation fund. With its limited size, reduction of agricultural production is possible; given an adequate size, it would be very expensive and require much time for its creation. The possibility is not excluded that in the first 10 years, income from the reorganized lands will decrease. Thus, for example, according to the calculations of Sredazgiprovodkhlopok, losses from it for the republic as a whole during the period of reconstruction will reach in excess of 1,240 million rubles. They will be subsequently made up, but it is impossible not to take them into consideration, as this will not occur quickly.

According to the calculations of planning organizations, specific capital investment for the comprehensive reconstruction of all parts of the irrigation network with concomitant measures, aside from the settlement of farmsteads, is estimated at 3,000-3,500 rubles and over the long term up to 4,000 rubles per hectare; 8-10 billion rubles will be required for carrying out this work on the specified area. As a result of work done yearly on the reconstruction of irrigation systems, their efficiency in the period from 1950 to 1975 increased from 0.45 to 0.56, or 25 percent. While the rate of reconstruction continues at its former level, the achievement of an efficiency for the systems on the order of 0.75 would require about 35 years. As the result of the reconstruction of irrigation systems of the republic, savings of water resources after exclusion of returned waters could amount to 2-2.5 km³. Such an amount of water does not solve the problem of the deficit of water resources. The water saved will be used locally for increasing the water supply of already irrigated lands.

For the entire area with old-built systems, about 1 million hectares of land in the UzSSR are to a varying degree contaminated with salt, the extent of the collector-drainage network is about 20 meters per hectare, which is below the norm. The salinity of the water of the Syrdar'ya in its lowest reaches (near Chardar'ya) exceeds 1.5 g/l; drainage and ground water with a mineralization of 3-4 g/l has to be used for irrigation because of the shortage of water. All this creates a real necessity for the development and implementation of measures for improving the reclaimed state of land.

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Major attention will be paid to improving irrigation equipment. For example, the ideal planning of surface fields eases and speeds up irrigation with a marked reduction of the watering norm, especially is supplied to the fields from pipe with regulated outlets.

Under certain conditions, sprinkling, droplet and intrasoil irrigation are highly effective, but their cost is higher than the cost of furrow irrigation. Droplet irrigation is applicable under conditions where the relief is steep or intersected and soils are strongly or unevenly permeable so that other irrigation methods would be impossible here. Because of high cost and other limitations due to natural factors, intrasoil irrigation is used on a small scale. Uzbekistan has approximately 250,000 hectares suitable for sprinkling.

In the republics of Central Asia, including Uzbekistan, it is expected that over the long term the furrow method of irrigation will remain predominant and involve the use of the resources of small-scale mechanization: siphon pipes, flexible joints, single dam irrigators and the like; their use boosts labor productivity in irrigation and improves its quality. But the employment of such irrigation methods does not significantly economize water.

To determine the size of the area of possible irrigation on local flow, it is necessary to know what will be the norms of irrigation, the efficiency of the reconstructed systems and the water resources of local sources. According to data of scientific institutions, irrigation norms with growth of crop yields will increase and amount to over the long term on the average 9,200-9,400 m³ per hectare (net).

The flow of the Aral Sea for a year of 90 percent provision is distributed among the republics of Central Asia. The irrigation capability depending on irrigation norms and the efficiency of the irrigation systems has been determined. The limit of water for the irrigation needs of the Uzbek SSR has been set at $55.5~{\rm km}^3$ per year.

With account being taken of the planned tempi of work on reconstruction of the network, the UzSSR Ministry of Land Reclamation and Water Sources in its calculations employs an efficiency for the irrigation systems over the long term of 0.68-0.70. If the irrigation norm be taken net at 9,200 m³ per hectare, then the irrigation area at this level for Uzbekistan utilizing one's own resources could total 4-4.1 million hectares.

The maximum possible irrigation area for the republic from one's own water resources in the remote future with an efficiency of the systems boosted to 0.75 and recommended irrigation norms will amount to 4.3-4.4 million hectares. On the basis of the tasks set before the republic, it was planned to have the area of irrigation land reach over the long term 5 million hectares. But as the result of the deficit of water resources, the areas of irrigated land may be significantly reduced.

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In validation of the necessity of diverting Siberian water, major significance was attached not only to the exhaustion of the free reserve and growth of the deficit of water resources, but deterioration of their quality as the result of possible increase of the level of mineralization and contamination with harmful wastes of agriculture, industry and transport. According to a forecast of the Central Asian Scientific-Research Institute of Irrigation, the content of mineral salts in the irrigation water of the lower reaches of the Amudar'ya during the period of leaching and vegetation irrigation operations, now amounting to 0.8 g/1, could grow over the long term to 3 and in the remote future even to 5 g/1 of irrigation water. Deterioration of the quality of water resources could be particularly marked in the lower reaches of the Syrdar'ya and the Amudar'ya.

Vegetation irrigation with water of increased mineralization will produce accelerated salinization of the irrigated land: during a season with an irrigation norm of 15,000 m³, 45 tons of salts will be added to a hectare with 3 g/l and 75 tons with 5 g/l. The consequence of intensive salinization of the land as the result of high mineralization of irrigation water will be reduced yield and even the complete dropping out of the irrigated lands from agricultural production. The situation is complicated by the fact that accelerated salinization will be observed with a deficiency (more correctly absence) of fresh water for leaching irrigation operations. Leaching with mineralized water is of little effect; more over, it results in additional addition to the soil of 15-25 tons of salts per hectare on a yearly basis.

Water protection measures are of major significance for reducing the mineralization of water and salinization of the land. Regulation of river flow, construction of water reservoirs, concrete coating of canals, transition to methods of irrigation of fields with the aid of concrete courseways and water pipelines [trubovody] and other progressive methods of reducing filtration and economic use of water resources will exert a favorable influence on improving their quality, especially in the lower reaches of the Amudar'ya and the Syrdar'ya.

The effect of the flow of Siberian water on reducing mineralization of the water of the Amudar'ya (and correspondingly the Syrdar'ya) and the possibility of using them for the needs of the national economy depend on the degree of mineralization of the Siberian water as well. Various scientific institutions have variedly determined it--from 0.2 to 1 g/l. Corresponding calculations have shown that the diversion into the delta of the Amudar'ya of 9 km 3 of Siberian water will lower the mineralization of the water (mixed) by 1.5-1.7-fold compared to the initial mineralization (3 g/l) and even with a most high concentration of salts in the Siberian water (1 g/l) mineralization will be below 2 g/l. Further increased size of the diversion will improve the quality of the water even more.

Thus, the conservation and protection of the quality of water resources constitute an intricate complex of progressive measures that as a whole ensure the suitability of water resources for irrigation. One of the most important measures is that of diverting Siberian water. The Basic Directions of USSR Economic and Social Development for 1981-1985 and for the Period to 1990 provide for the continuation of scientific and planning developments for directing a part of the Siberian rivers to Central Asia and Kazakhstan. The need for increasing the

efficiency of use of water resources was indicated in the decisions of the November (1979) Plenum of the CPSU Central Committee and the 15th Plenum of the Central Committee of the Communist Party of Uzbekistan.

The acuteness of solving these problems is to be explained by the fact that the rate of reproduction of the population of the Central Asian republics exceeds roughly threefold the average union rate. Therefore one of the chief social tasks is provision of full employment of the ablebodied population. The problem of employment is closely related to social-economic tasks of increasing the national income and per-capita consumption fund as well as provision of the population with foodstuffs.

The drop in the level of the Aral Sea is exerting an unfavorable influence on the environment and the social-economic development of the lower reaches of the Amudar'ya. The probable ecological consequences of the drying out of the sea, according to data of scientific institutions (Institute of Geography of the USSR Academy of Sciences and others), are cooling of the climate, drying out and turning into a wasteland of the delta and floodplains of the rivers, intensive salinization of soils, reduced productivity of pasturages and so on. The reduced potential of the Aral region as the result of these processes will create additional difficulties for economic growth and social development of the region.

With the drying out of the sea, the turning into a wasteland of the Amudar'ya's delta will proceed more intensively over an area in excess of 500,000 hectares. The only way of saving the land of the delta is to be found in the development there of rice growing, melon cultivation, alfalfa growing for seed and with the creation of a reliable feed base--and of meat stockraising.

Diverting part of the flow of Siberian rivers will exert a major influence on many aspects of the economy and social life of the republics of Central Asia and South Kazakhstan. At the present state of study of this problem, the most feasible method of assessing the effectiveness of the diversion on the basis of indicators of additional production of the gross product, the national income and growth of employment of the ablebodied population in production is per unit of transported water resources, that is, per cubic kilometer. Without setting as a goal the complete elucidation of this question, let us show the effect of the transported Siberian water on the materials of Uzbekistan-the biggest and most typical part of Central Asia and South Kazakhstan.

For example, in 1975 one cubic kilometer of water used in agriculture resulted in a gross production of 78.2 million rubles, a net production of 47.8 million rubles and enterprise net income of 18.2 million rubles.

According to our calculations, over the long term, on the basis of a certain improvement of the organization and management of water resources, the average use of water resources per hectare of sowing will be reduced by 15-20 percent, while the fertility of soils and yield will grow somewhat. The consolidated (integral) index of increased effectiveness of production per km³ of water resources according to a forecasting (expert) evaluation could grow 1.6-fold compared to 1975. (For a more detailed exposition see "Sotsial'no-ekonomicheskiye

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problemy perebroski chasti stoka sibirskikh rek v Srednyuyu Aziyu i Kazakhstan" [Social-Economic Problems of Diverting Part of the Flow of Siberian Rivers to Central Asia and Kazakhstan]. Tashkent, izd-vo "FAN" UzSSR, 1979, pp 52-56.)

Computation of the economic gains of using the water resources should include production and income not only produced in agriculture, but also in the industrial sectors of the agroindustrial complex. In accordance with earlier presented data, gross production per km³ of used water resources in all the sectors of the agroindustrial complex amounted to 317 million rubles and gross income to about 200 million rubles. According to the data of the scientific forecast, these indicators will grow over the long term for gross production to 500 million rubles and for gross (national) income to 320 million rubles.

Of major significance for reimbursement periods of capital investment relating to the diversion of Siberian water is the additional net income for each cubic meter of water resources. With this end, it is necessary to take into consideration not only the net income of agriculture and the profit of industrial enterprises of the agroindustrial complex, but also the income of the state from processing of agricultural raw materials into final products sold at retail prices.

According to our calculations, capital investment for diverting Siberian water to Central Asia will be recovered in 7 years from additional net income.

The growth of all produced national income and accumulations, as well as of a part of it realized in the republic itself and beyond its borders in other regions of the USSR, achieves major significance as a source of funds for the creation of an additional number of work places and assurance of full employment of the ablebodied population.

On the basis of growth of the indicators of production and prospective norms of worktime expenditures per unit of different products, it has been estimated that each additional cubic kilometer furnishes the possibility of providing productive labor in all sectors of the agroindustrial complex for 43,000 persons, including no less than 32,000 persons in agriculture.

There will also be prevented certain major losses of the national economy due to reduction of the natural potential of the Aral area from salinization of irrigated land, degradation of the soils of the delta and the floodland of the rivers and the geographic shift of cotton planting to the south and additional outlays for expending its sowings in the southern oblasts and so on. (For more details see the article by K. Lapkin and E. Rakhimov "Experience of Social-Economic Evaluation of the Consequences of the Drying Out of the Aral Sea" in the journal PROBLEMY OSVOYENIYA PUSTYN', No 2, 1979, pp 84-90).

Thus, the inflow of Siberian water in the amount of 15 $\rm km^3$ and subsequently 40 $\rm km^3$ will provide the possibility of boosting water availability for previously irrigated lands, and in addition of irrigating 1 million and then 2 million hectares. This will make it possible to introduce crop rotations at all the farms, to increase the area of irrigated land for rice, orchards and vineyards, vegetables, fodder plants and to more fully provide the population with products

61

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of animal husbandry from its own resources. Agriculture will become more intensive, and the national-economic complex of Central Asia and South Kazakhstan will be further developed.

Scientific and planning studies on diverting of the waters of Siberian rivers to Central Asia and Kazakhstan in accordance with the "Basic Directions of USSR Economic and Social Development for 1981-1985 and for the Period to 1990" will have to be based on national-economic criteria of rational distribution of water resources. This presupposes a comparative evaluation of irrigation farming and the whole complex of sectors according to regions of the subcommand zone of the arterial canal Siberia--Central Asia.

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PROGRESS ON RIVER DIVERSION PROJECTS REVIEWED

Moscow TRUD in Russian 6 Jun 81 p 1

[Article by A. Kuchushev: "Water for Southern Arable Lands"]

[Text] The development of a technical plan for the first phase of diverting a portion of the flow of north European rivers into the Volga Basin has commenced at the All-Union Leading Planning-Research and Scientific-Research Institute for the Diversion and Distribution of the Flow of Northern and Siberian Rivers imeni Ye.Ye. Alekseyevskiy.

The 26th party congress called for preparatory work to be carried out in connection with diverting a portion of the flow of northern rivers into the Volga River Basin. The need for this large-scale national economic program arose as a result of two urgent tasks. The first -- the creation of zones for the guaranteed production of agricultural products and for ensuring a normal operational rhythm for enterprises in the southern Ukraine, the northern Caucasus and the Volga region.

The second task of the mentioned work is that of replenishing the volumes of the Caspian and Azov Seas and improving the water balance of the Volga, Kuban', Don and other rivers.

We have been informed by the Deputy Director of the institute imeni Ye.Ye. Alekseyevskiy, V. Altunin, that the preparation of the technical-economic justification for diverting a portion of the flow of the Sukhona, Onega and Pechora rivers into the Volga has just been completed. The first phase of this program calls for the water of the Onega and Sukhona rivers and the Onezhskiy, Kubenskiy, Lacha and Vozhe lakes to be directed to the Rybinskoye Reservoir along the Volgo-Baltiyskiy Canal, which will be completely reconstructed. In addition, this reconstruction will make it possible to improve navigation and raise the output of electric power at the GES of the Volga Cascade.

"Exactly what is included in the preparatory work called for by the 26th party congress?" such was the question we addressed to the chairman of the Scientific-Technical Committee of the USSR State Committee for Science and Engineering and 1st Deputy Minister of Land Reclamation and Water Management for the USSR, P.A. Polad-Zade.

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"This task" stated Polad Adzhiyevich, "is very extensive. First of all, the shortest route must be selected and one which meets the requirements with regard to geology and relief, compensatory and water-protective measures must be carried out and a construction base established. Allow me to cite just one example. The northern rivers, especially the Sukhona, are clogged up with the waste products of timber rafting and timber processing over a considerable length of their channels. Initially it will be necessary to carry out water-protective work and only thereafter will it be possible to divert a portion of the flow of the rivers. Moreover, it will be necessary to build or expand purification installations at Vologda and in other industrial centers and to modernize a number of facilities. A considerable amount of work remains to be carried out here. Indeed, even the power pumping equipment is for all practical purposes being created anew. Tremendous importance is being attached to displaying a thrifty attitude with regard to the land. And although the water is intended for use in the arid steppe regions and by cities and villages, nevertheless the areas to be flooded by the artificial seas must be limited to the maximum possible degree. This is also one of the more important problems to be solved during the carrying out of the preparatory work.

The work of replenishing already existing reservoirs and expanding the scales of irrigation will make it possible to add a new branch to the Volga-Don Canal. The technical-economic justification for constructing this important project was approved only recently and the technical planning has commenced. Water from northern rivers will flow along this route to the northern Caucasus and then along the Rostov-Krasnodar Canal to the arid steppe regions in Krasnodarskiy and Stavropol'skiy Krays. This will make it possible to add vast areas of fertile land to agricultural production.

The diverting of the northern rivers into the Volga Basin is entering the practical stage. The experience accumulated in various regions of our country will be of assistance in successfully carrying out this national economic program.

7026

4

CSO: 1824/297

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SCIENTIFIC AND TECHNICAL ANALYSES

SOVIET HYDROLOGIST SAYS RIVER DIVERSION NOT A NEAR-TERM SOLUTION

[Editorial Report] The USSR monthly journal PRIRODA in Russian carries in its February edition a 3,000 word article by Doctor of Geographical Sciences Nikolay Timofeyevich Kuznetsov. Doctor Kuznetsov is a senior scientific coworker at the Institute of Geography of the Academy of Sciences, a specialist on arid hydrology, and the author of works on the surface waters of Central Asia. In recent years he has been a scientific leader of complex research on problems of the Aral Sea.

The article "The Future of the Aral Sea and the Aral Basin" is devoted to how best to preserve the ecology of the Aral Basin. Doctor Kuznetsov does not look to river diversion as a near-term solution to the area's problems, noting near the end of the article, "Finally, it has become obvious that the carrying through of measures, directed at the liquidation of undesirable consequences of the decreasing level of the Aral Sea, should go forth immediately, not waiting for the diversion of the flow of part of the Siberian rivers into the basin of the Aral Sea. This necessity is called forth by the fact that otherwise there could be development of irreversible processes and phenomena, the consequences of which at the present time are practically unpredictable."

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REVIEW OF BOOK BY S. L. VENDROV ON PROBLEMS OF TRANSFORMATION OF USSR RIVER SYSTEMS

Leningrad IZVESTIYA VSESOYUZNOGO GEOGRAPHICHESKOGO OBSHCHESTVA in Russian Vol 113, No 1, Jan-Feb 81 pp 61-63

[Review by N. I. Makkavayev of book "Problemy preobrazovaniya rechnykh sistem SSSR" [Problems of Transformation of USSR River Systems] by S. L. Vendrov, Gidrometeoizdat, Leningrad, 1979, 206 pages]

[Text] For nearly 40 years of this century, world water resource data were classed with subjects which seemed purely academic and impracticable. Nascent water management problems were usually confined to a local setting with an essentially limited impact and no interconnection. But even before the white patches on hydrographic maps had been completely filled in, it had become evident that fresh water supplies were limited and were already small enough that the water of rivers and oceans could easily be threatened. Therefore, water is a substance of the natural environment subject to strict protection, especially since there is already an acute shortage of water where it is most needed. Water management problems have gradually taken on a global character but bitter experience has quickly shown that no single problem related to water resource use can be solved without taking into account the processes in the geographical environment that occur in conjunction with water.

Using the example of USSR rivers, lakes and adjoining seas, S. L. Vendrov's interesting book gives an idea of the complexity of the problems resulting from the marginal conditions, including the totality of socioeconomic, natural and geographic factors. A broad circle of geographers, working in the field of water resource utilization and environmental protection, should become acquainted with this book. Although the author employs simple, intelligible language without resorting excessively to special jargon, this study does not belong to the category of so-called popular scientific literature. In brief, almost concise form, the book presents and evaluates different possibilities for solving many water problems along with the reasons for the author's own opinions on the most advisable courses for future research.

The book consists of two parts. In the first, general water resource use problems are reviewed; in the second the characteristics of contemporary transformation of the USSR river system are given.

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The first part begins with estimates of the overall magnitude of water supplies on the planet, specific river flow allowances per capita of population and the magnitudes and distribution of hydropower potential. Based on studies by the GGI [State Hydrological Institute] and the Institute of Geography of the USSR Academy of Sciences, a reduction in the river flow is predicted for the next decades. With an overall reduction of flow in individual dry years, the normal water supply may be disrupted, which dictates the need to develop long-term flow regulation. A separate section deals with a very serious problem, the cost of water both to the consumer and in monetary terms. A plan is proposed for determining the latter and the possibility of rapid and radical reappraisal of value is also pointed out. "Although river reconstruction was oriented mostly toward using water for generating electric power several decades ago, now the principle of using electric power to produce water, that is deliver it to the consumer, is being introduced more widely all the time" (p 27). Closely connected with the cost of water are problems concerning the territorial distribution of industrial and agricultural production. Hence, the prospects of general proposals for systematic use and storage of water resources at various levels are of great importance.

The problem of water quality is stated concisely but its main aspects are covered. The lack of uniformity in quality standards is stressed; for instance, salinity is 10.5 percent for schools of fish in the Azov Sea while it is 13.6-14 percent for the eastern part of the central Caspian. Water quality preservation may be complicated by the fact the pollution may come from 1) the atmosphere, 2) soil and fertilizer wash-out, 3) inadequate waste water purification and 4) adverse effects of flow regulation. Consequently, systems of protective measures must also be differentiated.

Serious attention is also focused on one of the most challenging problems of the river-sea system. The Aral Sea, along with the border seas Azov, Black and Baltic, is considered an example of the fate of internal drainage basins. One must agree with the author that the construction of dams isolating them from the ocean is not a panacea that would save seas like the Azov. Immediate elimination of the shortage in the river water in flow is necessary. However, the author's prediction of an expected change in the chemism of the Baltic Sea, based on the example of the Black Sea, would possibly be less dismal if the results of research by K. K. Zelenov were taken into account, in which the main source of hydrogen sulfide contamination of the Black Sea is juvenile water. The picture of the "death agony" of the Aral Sea resulting from use of the Amudar'ya and Syrdar'ya for irrigation seldom mentioned in the literature, is impressive.

A large section is devoted to the problem of territorial distribution of the flow in light of the need to develop a uniform water management system for the country. Different flow diversion possibilities are listed and the need for thorough preliminary evaluation of accompanying measures to change the natural environment is stressed. The proposal dealing with water diversion from the lower reaches of rivers which would permit diversion of the flow of northern rivers without sacrificing land suitable for reservoir construction and without disturbing natural conditions along the valley deserves attention.

Interesting questions are raised about the river and city problem. The rapid change in the nature of urban and suburban areas, the increase in water consumption and the volume of waste water and the change in the flow factor are creating exceptional dynamics of hydrogeological conditions here. Above all, the hydrogeography is being radically modified. For instance, of 118 earlier existing rivers and streams within Moscow, 67 have been put into pipelines and 47 have been filled in. On the other hand, the drain system has reached a length of 200 km. The floodplains of the Moscow and Yauza rivers have been filled in by a depth of 4-10 m. Historically, it has happened that the majority of large cities were located on the banks of rivers and the river-city problem is becoming the basis for a new division of hydrology.

In the second part of the book, a synopsis of a number of regional water management problems within the USSR is presented. Special attention is focused on the Volga-Kama cascade hydrosystem, completion of which is planned for the near future. It is characteristic that this cascade, which has an enormous total capacity for water storage, will be able to fully implement only seasonal regulation of the flow.

A series of questions relating to reservoirs is considered in the remaining chapters of the second part. Here, the author summarizes the abundant experience of long-term personal research. The scale of the transformation of the river flow and of the coastal zone landscapes by reservoirs is evaluated, the basic indicators which characterize USSR reservoirs are given and they are ranked with man-made water storage facilities of other countries and the reservoir classification is substantiated. The reasons for the increase in the cost of hydrosystem development are analyzed. The author believes the main reason to be an increase in the cost of land. Over the past 20 years, there has been a three- to eight-fold increase in the cost per unit of water area of reservoirs. Reservoir operation is gradually having to change. Even recently, large hydrosystems were planned primarily for generating electric power. Now, ever more adjustments are being made in water use to accomodate the needs of fish breeding, agriculture, water supply and recreation. For instance, a considerable amount of free-running (not in turbines) water run-off is having to be produced from lower Volga reservoirs to irrigate bottom land and create favorable conditions for spawning fish. In the Volga delta, a special water divider has been built to redistribute high water from the river to provide for optimum salinity in the eastern part of the pre-estuarine coastal waters.

There is independent interest in analyzing the lithodynamic processes of coastal zones and the formation of a sedimentary layer. In the plains products of shore denudation constitute the bulk of deposits in reservoirs. In the mountains river-borne sediments account for most of the deposits.

Only a few of the topics covered in S. L. Vendrov's study which is rich in factual material, abounds in descriptions of different possibilities for solving water management problems and full of original ideas are mentioned in this review. Similar studies in which the results of complex physiogeographical, economic,

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geographic and technical research are presented should be republished frequently since, in this century of scientific and technical revolution, technical ideas, problem-solving methods and scopes of information change rapidly. It would be highly desirable if the next edition of this work by S. L. Vendrov were issued in a considerably larger number of copies since the demand for such books is very high.

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8945

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WIDER USE OF BLASTING FOR CANAL CONSTRUCTION ADVOCATED

Moscow GIDROTEKHNIKA I MELIORATSIYA in Russian No 3, Mar 81 pp 24-27

[Article by N. S. Grishenko, A. A. Vovk, and O. A. Chernyshenko: "The Technical-Economic Advisability of Using Blasting in Land Improvement Construction"]

[Text] Successful performance of plans for land improvement construction involve an enormous and constantly growing volume of earthwork. In the 10th Five-Year Plan this volume was about 40 billion cubic meters. At the same time, the growth in the fleet of earthmoving machines is lagging behind growth in the volume of earthwork, and the productivity of these machines is still low. The use of blasting in earthwork eliminates the need for a large number of earthmoving machines and makes it possible to reduce expenditures for purchasing them, cut labor expenditures, and save additional expenditures for construction of social-domestic and cultural facilities and training skilled cadres for operating earthmoving machines. We might observe that millions of rubles are spent for housing construction in undeveloped regions.

According to the figures from the technical-economic substantiation for construction of the large Transvolga trunk canal, labor expenditures are 354,915 worker-days using earthmoving machines and 226,476 worker-days using blasting. Work on earthmoving machines will require 514 workers a day. Expenditures for the construction of social-domestic facilities will be almost 2 million rubles.

Long years of experience have demonstrated that the use of blasting in construction of land improvement facilities under different natural conditions significantly increases labor productivity and reduces the time required to put projects into operation and begin using improved land (2-3 and 1.5-2 times respectively). In construction of the fourth phase of the Karakum Canal, for example, each shift worked a canal section from 60-80 to 150-200 square meters for a length of 500-700 meters by using blasting. The work was done by a brigade including one blasting expert and several workers. A brigade was equipped with a multibucket excavator, trencher, and bulldozer. The productivity of one worker was about 10,000 cubic meters per shift. With earthmoving machinery they could not cover more than 100 meters of canal per shift in these conditions, and labor productivity is one-third to one-fourth as high.

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The quality of work is better with blasting, and the bottom of the excavation is strongly compacted, which reduces filtration from the canal.

Broad application of blasting is being held back by the relatively high cost of working a cubic meter of ground. But this approach to evaluating the efficiency of blasting in land improvement construction is one-sided, because it does not consider the final results.

In the stage of technical-economic substantiation of construction technology the most important criterion for selection of an alternative is calculated expenditures, that is, the prime cost of doing the work (current expenditures) and the cost of the productive capital used in the construction process (one-time expenditures) multiplied by the coefficient of efficiency. A comparison of the calculated expenditures for different alternatives makes it possible to identify the most progressive and economical method of doing the work.

But this only identifies efficiency in the construction stage. A full and objective evaluation of alternatives must also identify efficiency in the stage of operating the project and take into account all types of effects from reducing construction time. This method of calculation will reflect most fully the wisdom of the alternatives being selected because it will disclose capital investment by years of construction, a key indicator which determines the level of efficiency of the expenditures being made. The calculation of expenditures should consider the part of the prime cost of construction-installation work, which besides being very important, is not included in direct expenditures or overhead. This part is directly proportional to the number of workers and their total wages. (This includes supplementary pay resulting from a raise in wages for middle-category workers, which is not included in direct expenditures, and expenditures related to the piece-rate-bonus system of wages, which are not included in the cost of construction-installation work).

According to calculations, the profit that is received from introducing improved lands into use ahead of schedule not only compensates for the additional expenditures but exceeds them. Therefore, when compiling plans the possibility of using blasting and the efficiency of expenditures in the process of building and operating projects must be considered. Earthwork technologies based on blasting are most progressive because, with an overall growth in the public productivity of labor the share of past labor is rising significantly and the share of live labor is declining. This is extremely important for rational use of productive forces. Expenditures for explosives constitute 60-90 percent and more in the total cost of blasting work, while the share of wages is 1.5-10 percent (where earthmoving machines are used wages are 25-40 percent).

The use of blasting makes it possible to intensify expenditures of resources (materials, labor, and finances), that is, to use a greater concentration of past and live labor per unit of time.

Further development of technologies based on blasting and the scale of their application in land improvement construction depends significantly on the development and ratification of norms, a system of evaluation and comparative technical-economic indicators, and methods of calculating the efficiency of using blasting.

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One of the fundamental defects of current evaluation techniques is the lack of an interrelationship between the effect of blasting on operating parameters and properties of excavations and the final economic indicators. This interrelationship must be taken into account when solving the problem of optimizing the initial parameters of blasting. An increase in the parameters of the excavation made by blasting increases not only the expenditure of resources, but also the profit received from operating a structure with larger parameters. On this basis it is possible to determine the volume (or stages) of construction by the area of the canal cross-section or length. This is important in building large projects such as the canals to divert part of the flow of the Siberian and northern rivers to the Aral Sea and the Volga basin.

The parameters of the canal (L=2,300 kilometers; H=40 meters, and B=up to 350 meters) for diverting part of the flow of the Siberian rivers and the correspondingly enormous volume of earthwork, the extended nature of the work front, and the complex natural conditions will require corresponding capital investment. Therefore, it is important that the organization of canal construction by phases guarantee that improved lands can be put into use during the very first period of construction work.

A convincing example of the advisability of building a large canal in phases is the diversion of water from the Amudar'ya River to the southern and western regions of Turkmenistan. By the start of 1979 the Karakum canal zone had 535,000 irrigated hectares. Because the canal was launched in phases expenditures for construction had already been repaid while investment was 16.61 billion rubles, while net income (in the form of the turnover tax) from sale of the output of cotton processing was 1,432,500 rubles. In the case of three sovkhozes, Moskva, 50 Let SSSR, and Karakumskiy Kanal, capital investment totaling 63.2 million rubles was repaid in five years.

A distinctive feature of construction of the canal was the establishment of stages within each phase (by length of the canal) and the construction of a pioneer canal. During the process of operations the canal was widened to the planned dimensions by dredges. For construction of the pioneer channel of the fourth phase of the canal plans envision plasting out the excavation with linearly elongated charges.

Our experience in building the Karakum canal confirms the wisdom of building the canal to divert the waters of the Siberian rivers in phases. According to technical-economic substantiation data developed by the All-Union State Planning Institute for Water Management and the work of the Trust for Drilling and Blasting Operations of the Main Administration of Special Industrial Construction, it is advisable to do the blasting work in segments of 1,017 kilometers (see Table 1 below).

Where only earthmoving machinery is used the cost of one cubic meter of excavation is 0.55 rubles, but the time of construction will increase by three years.

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Table 1. Basic Technical-Economic Indicators of Construction of the Diversion Canal by Blasting Out

	Segments of Canal Route			Total for Route
Indicator	I	II	III	IV
Length of Segments, km	207.5	485.0	324.8	1,017.3
Projected Volume of Excavation, thousands of m^3	399,385	1,000,555	684,460	2,084,400*
Average Cross-Sectional Area, m^2	1,924	2,063	2,104	2,049
Usable Debris, %	68.8	76.7	69.1	72.7
Average Cost of Canal: Rubles/m ³ Rubles/km	1.05 13,837	0.77 1,035	1.10 1,587	0.92 1,375
Labor Productivity . m ³ /Worker-Shift	1,111.6	1,750.4	1,404.0	1,483.2
Construction Time, years	7	7	7	7

*[Russian text reads, "20,844,000," an apparent error.]

According to data from the Trust for Drilling and Blasting Operations, the use of blasting will make it possible to double labor productivity and reduce construction time by 20 percent, capital investment by 50 percent, the need for earthmoving machinery by 40 percent, and the need for labor by almost 40 percent.

Experience shows that single-trench detonation of explosive charges is most efficient. Because the canal is roughly 10 times as wide on top as it is deep, it is necessary to determine the optimal area (S) of the cross-section of the pioneer canal for which the national economic impact in the process of operation will be maximal. The technical-economic heart of this question is to maximize the elements of profit growth in comparison with the element of growth in total expenditures related to the unit of measurement of the final result of construction given a definite (unambiguous) value of S.

Analysis of the results of an approxiamte calculation of the technical-economic efficiency of building the pioneer canal by blasting out where Q=1,000 cubic meters per second and S=1,700 square meters showed that the optimal value of S was approximately 600 square meters when Q=420 cubic meters per second. The weight of the explosive charge per meter of length in this case is 1,200 kilograms placed at a depth of 10 meters. It is economically advisable to use blasting to make a pioneer canal whose cross-sectional area is 42 percent of the planned area; the technical-economic efficiency is less where this area is increased or decreased.

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During construction of the collector network it is often necessary to greatly intensify earthwork. For example, during construction of collectors in the Karakum canal zone the use of blasting makes it possible to significantly speed up the introduction of earthen structures and raise the efficiency of capital investment in land improvement. The reduction in construction time for the Kaakhkin central collector from 18 to eight months for the Western interfarm collector from 14 to five months, and for the Tedzhen southwestern collector from 22 to 16 months, made it possible to save more than 6 million rubles (see Table 2 below). Under these same conditions the construction time for collectors using earthmoving machines in fact exceeds the projected time.

Table 2. The Economic Efficiency of Using Blasting in Construction of the Collector Network in the Karakum Canal Zone

14	lechanized		Kaakhkin Central Collector Blasting Using:		
Indicator	Method	Igdanite	Ammonite	Granulite	
Total Estimated Cost, rubles	216,000	607,000	1,222,000	1,098,000	
Prime Cost of Con- struction-Instal- lation Work, rubles	204,000	573,000	1,153,000	1,036,000	
Capital Investment in Production Capital, rubles	216,000	607,000	1,222,000	1,098,000	
Construction Time, months	18	8	-	-	
Labor Expenditures, worker-days	6,290	3,907	3,495	3,907	
Calculated Expen- ditures, rubles	225,000	498,000	1,000,000	901,000	
Supplementary Economic Impact, rubles	-	-	2,059,000	-	
Full National Economic Impact, rubles	-	1,786,000	1,284,000	1,383,000	

[Table continued next page]

74

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[Table 2 continued]	Western Interfarm Collector			Tedzhen Southwestern Collector	
Indicator	Mechanized Method	Blasting Method	Mechanized Method	Blasting Method	
Total Estimated Cost, rubles	181,000	931,000	1,969,000	2,913,000	
Prime Cost of Construc- tion-Installation Work, rubles	171,000	879,000	1,857,000	2,748,000	
Capital Investment in Production Capital, rubles	181,000	931,000	1,967,000	2,913,000	
Construction Time, months	14	5	22	16	
Labor expenditures, worker-days	5,582	4,754	65,780	56,700	
Calculated Expenditures, rubles	192,000	775,000	2,033,000	2,699,000	
Supplementary Economic Impact, rubles	-	2,409,000	-	3,481,000	
Full National Economic Impact, rubles	-	1,826,000	-	2,815,000	

It is advisable to build the collector networks for the existing Caspian and Chernozemel'skiy irrigation systems by blasting. Construction of this network with earthmoving machinery will take five years. The gap in time between the introduction of irrigated lands in the Chernozemel'skiy irrigation system and the runoff collector leads to constant groundwater flooding of the estuaries over a significant area and results in considerable loss to agricultural production. But the use of blasting will make it possible to cut construction time from four to two years. As a result, the volume of production of economic output will increase and the economic impact will be more than 2 million rubles (see Table 3 below).

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Table 3. Basic Economic Indicators for Alternatives of Constructing the Chernozemel'skiy Collector

or const.	Capital Investment, rubles	Calculated Expenditures, rubles	Discount Factor	Discounted Calculated Expenditures, rubles
Mechanized Method				
Year 1	1,592,000	1,665,000	1.1	1,513,000
Year 2	1,592,000	1,665,000	1.21	1,376,000
Year 3	1,592,000	1,665,000	1.331	1,252,000
Year 4	1,592,000	1,665,000	1.464	1,140,000
Total	6,368,000	6,660,000		5,281,000
Blasting Method*				
Year 1	4,504,000	4,817,000	1.331	3,619,000
Year 2	4,504,000	4,817,000	1.464	3,291,000
Total	9,008,000	9,634,000		6,910,000

*National Economic Impact of Blasting Method - 2,495,000 Rubles

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The decline in the cost of explosives and their use in complex ground conditions will make it possible to significantly increase the efficiency of blasting in land improvement work. Studies show that in flooded ground it is possible to use improved igdanite enriched with hydrophobic additives. The cost of this igdanite is 2 to 2.5 times lower than the cost of ammonite. According to calculations, such a substitution would make it possible to save some 1.5 million rubles in construction of the segments (total length of 140 kilometers) of the Transvolga main collector canal. In addition, comprehensive mechanization and automation of charge work is an important reserve for reducing the use of resources in blasting.

SELECTION OF STRATEGY FOR UTILIZATION OF WATER RESOURCES, INCLUDING RIVER DIVERSION, DISCUSSED

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA in Russian No 2, Mar-Apr 81 pp 30-33

[Article by A. I. Duvanin]

[Text] The shortage of fresh water, manifested with more and more certainty, has generated a search for the possibility of increasing the runoff in basins where a shortage of water is especially acute. The idea of solving this problem by diverting part of the flow of the northern rivers into rivers carrying water into the southern arid regions of the country took shape. Implementation of these plans is extremely expensive. Moreover, it is important that intrusion in the system of mainland runoff is inevitably contradictory to many of the natural processes interacting with this system. A considerable amount of research work is being carried out to predict the consequences of this intrusion which, however, does not guarantee that negative consequences will not appear. The simple discussions presented below can apparently be kept in mind when selecting the strategy of utilizing water resources.

Let us agree to consider only the realistically visible river flow within a certain basin among the entire water balance.

Let us denote Q as water flow rate in the gauging section, Q_{Σ} as the total water flow rate participating in surface streamflow of the basin, K as the coefficient of the combination of losses of streamflow caused by unforeseen natural processes--E (evaporation, filtration and so on) and by water intake for universal economic purposes--T, i.e., let us assume that

$$K = f(E, T)$$
.

With regard to the values adopted for consideration, the equation of the balance of expenditures under the stipulated conditions can be presented in the form

$$Q + \bar{K}Q = Q_{\Sigma}, \tag{1}$$

77

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i.e., the flow rate at the gauging section with regard to all losses of streamflow within the river system of basins is equal to the total flow rate participating in the surface streamflow of the basin.

It follows from (1) that

$$Q = \frac{Q_{\Sigma}}{1 + K}.$$
 (2)

This expression can be related to the total flow of many basins or to continents as a whole. The greater the spaces thus characterized in this manner, the more valid will be the well-known conclusion that the water resource is 90 percent determined by the external moisture circulation in the continent-ocean system.

Convincing data are presented in investigations on land hydrology on a decrease of river streamflow due to an increase of irreversible water losses with intensively developed production activity. In a recently defended doctoral dissertation on formation of surface waters, R. K. Klige determined the decrease of water resources of continents inherent for the modern state of the climate. He writes: "Investigation of the processes of global water exchange shows that under the existing climatic conditions directional variation of the water balance on the earth's surface will occur in the future, as a result of which the water reserves of the land will be reduced by a factor of approximately 133 km³ annually, while the volume of glaciers will be reduced by a factor of 183 km³ annually, with subsequent supplementation of the world ocean at the rate of 316 km³ annually" [1]. For orientation in these figures, we add that, according to data of the same author, the modern worldwide river streamflow comprises 44,182 km³ annually, while the total volume of water on land is a total of 58.4·10⁶ km³.

It is calculated that the total water consumption for different economic needs already comprises approximately 4,000 km³ annually, i.e., almost 8 percent of the worldwide river flow. It is assumed that this indicator will increase approximately twofold by the year 2000 [1].

One should add to the foregoing that, along with the indicated phenomena, increasing oil pollution of the ocean surface leads to a reduction of evaporation. As a result, there is the danger of additional drainage due to weakening of external moisture circulation between continents and oceans. This is indicated by data of steady evaporation in the presence of an oil film on the surface of the sea which indicate that the decrease of evaporation may comprise from 10 to 50 percent within the oil pollution spots. This rapidly increasing possibility of weakening of the external moisture circulation me its close study and quantitative analysis.

Thus, there are at least three globally manifested processes of identical trend which will lead in the foreseeable future to a reduction of the continental water resources. They should be taken into account when solving the problem of using these resources for the long term.

The search for the capability of increasing the flow rates of rivers which support development of industry and agriculture has as its purpose finding an additional flow rate ΔQ in order to find

$$Q_{\Sigma}^{1} = Q_{\Sigma} + \Delta Q, \tag{3}$$

 $\triangle Q$ may include more terms than those for which we are interested in here, assuming that

$$\Delta Q = Q_{\Sigma} \cdot f(S) + Q_{o} + Q_{n}, \tag{4}$$

where f(S) is determined by the total measures for conserving water resources, Q_{O} is the water flow rate possible due to distillation of sea water and Q_{D} is the water flow rate achieved by diversion of the flow from other river basins.

The use of underground waters and the capability of intensifying glacier melting, i.e., finite water sources to exploitation of which one must approach carefully, are deliberately not considered here.

The latter two terms $(Q_0$ and $Q_p)$ of formula (4) may not occur in all regions. However, where the use of distilled sea water begins, society is joined to a practically inexhaustible water resource. The achieved flow rates Q_0 will increase in time as technology is improved without negative consequences for the development of nature.

Diversion of water resources from other river basins (Q_p) where, strictly speaking, there is no surplus water since accumulation of moisture is not noted on the continents but on the contrary progressive drying of the continents intensified by anthropogenic processes occurs, is a quite different matter. Under these conditions redistribution of streamflow on large scales is an undesirable disturbance, not clear in consequences, in such a complex area of natural evolution as the water balance of vast territories. Water can be borrowed in the best case only within a limited range, quantitative analysis of which is very complicated. The anticipated effect from diversion of streamflow with a rapidly growing need for fresh water can only be a temporary and very expensive situation.

The given concepts acquire tangible clarity and development after substitution of Q_S^1 and ΔQ from (3) and (4) into (2), which yields

$$Q = Q_{\Sigma} \frac{1 + f(S')}{1 + f(E, T)} + \frac{Q_{o}}{1 + f(E, T)} + \frac{Q_{n}}{1 + f(E, T)}.$$
 (5)

Since Q_p in the last term is a decreasing value while $f(E,\,T)$ in the denominator will inevitably increase in time, the effectiveness due to diversion of river flow will decrease in the future and will approach zero. The value of Q_o in the second term may increase without limit or which is better to say may increase according to $f(E,\,T)$ with an increase of engineering capabilities. Consequently, the behavior of this term makes the contribution of funds to develop it rational for the future. This has obviously been understood in a number of countries where distillation of sea water is being developed.

The first term of formula (5) is interesting in its meaning. It indicates that the value of Q provided by natural water circulation may even achieve an increase if the fraction which denotes the ratio of water-conservation measures to the function of losses (natural and technogenic) is greater than unity. There is the clearly marked goal here of managing the consumption of water resources along the line of water conservation and a reduction of natural and economic losses of water.

Very large contributions of funds to the country's water management are inevitable. In view of the foregoing, they are rational for optimization of the last two terms of the future water resource. In their direction, all the efforts to which optimization of the first term will be related, correspond to improvement of the system of exploitation by society of such a vitally important natural resource as fresh water. Upon generalized analysis of the problem, streamflow diversion from some regions to other regions can be justified as a special measure of regulation when in the final analysis this will provide an increase of the coefficient of formula (5) at Q_{\sum} that meets the condition of profitable use of the resource. Diversion of river flow on large scales to bring some finite and essentially seeming moisture reserve into social production after realization of it leaves no other alternatives except returning to the first two terms of the total resource considered above. Is it not better from the very beginning to orient the strategy of material contributions to supply of water resources on the basis of the first two terms of formula (5)? Improvement of the exploitation of a realistically available water resource in nature and supplementation of this resource as need increases by distillation of sea water (the second term of formula (5)) are provided in them.

The meaning of the results for the second term can be seen in compensation of fresh water losses, inevitable in social production, from the world ocean. The water flow rate achieved by distillation may be regarded as supplementation of the effect of external moisture circulation when it becomes inadequate as society develops.

An example of the very undesirable degradation of the Sea of Azov, already begun, can be presented. In the principal sense, it is quite rational to stop this process by spanning the Kerch Strait and by delivery of water from the Black Sea (salinity of 16.5 percent), distilled to the salinity required to maintain the natural salinity of the Sea of Azov (10.5 percent). With the existing consumption of fresh water, it is obviously quite unrealistic to achieve positive changes in the condition of the Sea of Azov by diversion of fresh water of the northern rivers through the Volga and Don river basins. We touch on this example as the essence of the possible basis for solving the water-management problems of the south in this direction. There are many interesting aspects here which require special consideration in the technical and economic sense.

Thus, distillation of sea water, bringing it into social production and into natural cycles is equivalent to intensification of the moisture circulation between the ocean and continents, which will apparently become one of the timely problems of the life support of society in the near future.

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6521

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DISCUSSION OF SCIENTIFIC STUDIES ON USING VOLGA WATER RESOURCES

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[Article by G. V. Voropayev and T. N. Ivanova, Institute of Water Problems of the USSR Academy of Sciences: "Problems of Comprehensive Utilization of Water Resources of the Volga-Akhtube Floodplain and the Volga Delta"]

[Excerpts] Throughout the last two decades the problem of comprehensive utilization of water resources of the Volga basin has been one of the most crucial water management problems in the country.

Economically, the Volga basin is a most important region; about one-fourth of the population is concentrated here and one-fourth of the country's agricultural and industrial output is produced here. The Volga-Caspian basin provides one-half of the catches of fish from all of the country's internal waters and about 90 percent of the catches of fish of the sturgeon family [figure 1, figure 2]. The most important water consumers in the Volga basin are hydroelectric power, water transport, fishing, irrigated farming and municipal and industrial water supply. The problems related to management of the utilization of Volga water are complex and multifaceted. They require the solution of such other problems as multi-purpose utilization of water resources from water reservoirs, the quality of the water, the spring conditions for the release of water on the lower Volga (below Volgograd) under the conditions of a regulated streamflow, the maintainance of a certain volume of flow into the Caspian Sea in order to avoid lowering its level, and so forth.

Because of the increased water consumption in the Caspian basin and the arrears in the implementation of measures that reduce the rates of this increase and also reduce evaporation and augment the inflow into the sea, the water management situation into the basin will become even more complicated in the near future. There arises an additional complex of new questions related to the intended withdraw 1 of part of the water from the Volga to be transferred into the Don before we begin to compensate for this withdraw 1 by diverting part of the flow from northern and northwestern rivers into the Volga basin. Moreover, in the future the Volga will become not only a consumer not only of northern water, but also a route for the diversion of water into the adjacent basins of the Don and Ural [figure 3].

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But under present conditions, before the territorial redistribution of the water, the task of fuller and optimal comprehensive utilization of existing water resources of the Volga basin remains exceptionally complex and crucial. Moreover, as the experience of past years shows, there are real possibilities of adopting and implementing rational decisions concerning the allotment of water on the Lower Volga.

Since it is impossible to touch on all the diversity of problems of the Volga water management complex in one article, let us consider only the questions relating to comprehensive utilization of water resources in the lower reaches of the Volga (below the Volgograd hydroelectric power complex), that is, the Volga-Ahktuba floodplain, the Volga Delta and the western steppe lakes in the Volga Delta, taking into account, of course, the interconnection between the problems of this region and the overall tasks of controlling water utilization in the Volga-Kama basin.

While hydroelectric power engineering, water transport and irrigated farming in the Volga area are interested in accumulating water in the water reservoirs during the spring with its subsequent utilization throughout the course of the year, water consumers of the lower reaches of the Volga, primarily fishing and agriculture, are interested in maintaining the distribution of the river's water at a level close to the unregulated (natural) one throughout the course of the year. Moreover, the transfer of water into the river basin reduces the overall flow into the mouth areas and the northern Caspian, increases the amount of waste and returned water which is polluted by industrial and communal-household wastes, herbicides, toxic chemicals and so forth. This leads to a lowering of the level of the sea which is unfavorable from the standpoint of the reproduction and fattening of fish, to a distribution of the currents of fresh water in the delta and the northern Caspian, and to a reduction of the biogenic current and the feed base. All this creates conflicts which become more critical in dry years.

The existing forms of water management in the lower reaches of the Volga have become more complicated under the conditions of the natural flooding of the flood plains, the delta and the western steppe lakes of the Volga Delta during the spring high water season. And the accumulation of the spring stream flow in the reservoirs during the spring (the usual volume of accumulated streamflow necessary for filling the water reservoirs to the normal planned mark amounts to 60-70 cubic kilometers) actually precludes having the high water period on the Lower Volga in its natural volume, heights and duration. Therefore along with planning Lower Volga hydroelectric power centers, in connection with the expected changes in the hydrological conditions, we have planned a radical restructing of the lower reaches of the Volga: a changeover from extensive forms of management, which depend entirely on the spring high water time on the Volga, to controlled water management through improvement of spawning grounds, the construction of a water divider at the top of the delta, the creation of fisheries and spawning and growing areas, and artificial irrigation of agricultural land. But this program is being implemented extremely slowly. While certain measures have been taken in the area of fishing (a network of fisheries and spawning and growing areas have been created; in 1976 construction was completed on a water divider at the top of the delta which is intended for providing for reproduction

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of semi-anadromous fish through maintainance and improvement of spawning conditions in the eastern part of the delta, regardless of the hydrological situation, the spawning beds are being improved, and canals have been dug for the fish [figure 2]), in the area of agriculture almost no practical steps have been taken in this direction. This causes harm to all branches of the national economy, and, in the final analysis, considerably reduces the effect from comprehensive utilization of the Volga's water resources.

As for the methods of optimal distribution among the water consumers of the Volga water at our disposal, one should admit that water management science has still not met the demands of practics in regard to this issue and annual decisions concerning the volume and the hydrograph for release of water are adopted by directive agencies without proper scientific substantiation. The lack of economic criteria makes it impossible to evaluate reliably enough the harm that is caused to various branches of the national economy because of the limitation of water consumption during dry years and, consequently, to determine correctly the amount of special spring release of water into the lower reaches of the Volga. The methods that have been developed for economic substantiation of the utilization of water for fishing and agriculture are especially poor, which considerably complicates the solution to the problem. Still, a number of organizations are successfully conducting research in this area. In particular, a large amount of work has been done by the ENIN imeni G. M. Krzhizhanovskiy. The results of this research, after comprehensive and profound analysis and discussion, could be the basis of practical methods for distributing the Volga flow.

In the near future, before the beginning of the diversion of some of the flow from northern rivers into the Volga, the operating conditions of the water reservoirs of the cascade will be more difficult and less favorable for all of the Volga water management complex, including for the Lower Volga, because of the increasing unrecycled water consumption from the Volga and its tributaries. A considerable portion of the water will be removed during the vegetative period, which leads to an increase in draw off during the summer, and during dry years, to interruptions in the guaranteed releases of water for shipping below Volgograd. All this in the final analysis can lead to a deep draw off in the water reservoirs of the cascade in the period before the high water period and, consequently, to the necessity of using more water in the spring to fill them. Therefore the release conditions on the Lower Volga, as the main measure for providing for the interests of fishing and agriculture, will not be able to fully solve the problem of controlled water management.

An important stage in the creation of controlled water conditions in the lower reaches of the Volga is the water divider that was constructed at the top of the delta. With a reduction of discharge of water at the top of the delta to 12,000-14,000 cubic meters per second, it should provide for a guaranteed supply of no less than 8,000-9,000 cubic meters per second into the eastern branch of the Volga-Buzan in order to flood the eastern part of the delta. This unique hydrotechnical structure includes two ship locks, two ship basins with immersible gates, two fish ladders so that anadromous fish can move to the upper reaches, 33 water areas of the low-head dam with gates, a fixed dam which covers part of the river's bed, and a dike which divides the delta into eastern and western parts.

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The water divider makes it possible, with reduced expenditures of water at the top of the delta, to considerably improve conditions for the reproduction of semi-anadromous fish in the Volga-Caspian region, which is especially important during dry years. In the latter case, working at the end of the high-water season, the water divider makes it possible to considerably increase the length of the high-water season in the eastern part of the delta.

At the present time there are certain difficulties with putting the water divider into operation. These are caused mainly by the fact that the agriculture of this region (the western delta and the western steppe lakes of the Volga Delta) is not prepared for the conditions of its operation. Moreover, the work of the water divider, especially during the first years, can disturb the conditions for the migration of sturgeon since their basic breeding school migrates through the western shoals (up to 80 percent). The water divider's structures to allow fish to pass through are inadequate for sturgeon and therefore during its operation it is necessary to provide special transportation for spawning sturgeon into the upper level of the water divider's dam.

The water divider is actually the final stage of the hydrotechnical structures on the Volga and Kama, and the conditions for its operation should be coordinated with the operating con itions of the Volga-Kama cascade of hydroelectric power units and the hydrological, hydraulic, hydrobiological, icthiological and water management conditions in the delta and the Northern Caspian. The creation of the corresponding system of mathematical systems, computer programs and software for them would contribute to a successful solution to this problem. Existing mathematical models can serve as a basis for the creation of these models, particularly models for control of the conditions of the cascades of the hydroelectric power units, which solve individual problems related to the operation and design of water management systems, including the Volga.

Since the research begun at the Institute of Water Problems of the USSR Academy of Sciences using space methods is related mainly to problems of the Northern Caspian and the coastal mouth areas of the rivers and has not set the goal of solving water management problems related to optimizing the utilization of water and land resources of the Lower Volga, it would obviously be expedient to develop a program for a special space investigation regarding this problem, taking into account the specific nature of the necessary information, its precision, its periodicity and so forth.

A temporary scientific and technical commission was created in 1978 for developing proposals regarding regulating the utilization of water below the Volgograd water reservoir during the spring period for the needs of fishing, agriculture and power engineering and in connection with the operation of the water divider. The commission included representatives of all interested departments and scientific and planning organizations. Having analyzed the water management situation in this region during the last 20 years (that is, after the construction of the Volgograd hydroelectric unit) on the basis of a large amount of factual material, the commission developed a number of concrete recommendations. In particular, it recommended:

- l) in connection with the startup of the Lower Kama and the Cheboksary hydroelectric power complexes, to revise the rules for the utilization of water resources of water reservoirs of the Volga-Kama cascade; in the future, before the revision and adoption of the new rules, to not increase the existing total dispatch volume of draw off from the reservoirs before the high-water season to more than 60-70 cubic kilometers;
- 2) to improve the existing methods of prognosis, especially for anomalous conditions of water supply, to refine the basic prognosis correctly and promptly, and to make the prognoses more operational;
- 3) to take the necessary measures for eliminating obstacles to normal operation of the water divider--to increase the rates of work for reclamation of agricultural land and improvement of water supply for existing irrigated land, and to transform the eastern delta into a fish preserve zone, limiting the development of agricultural production there, especially rice plantings which require the application of toxic herbicides;
- 4) in order to increase the efficiency of the operation of the water divider, to create in the area before the delta normal paths for the passage of breeding fish that are going to the spawning beds in the eastern part of the delta, to step up full-scale hydrological, hydrochemical and icthiological research and regular observations of the operation of the water divider in order to evaluate its effects on the hydrological and fishing characteristics of the delta and the Northern Caspian, and also full-scale research for evaluating the effectiveness of the operation of individual structures of the water divider.

Taking into account the exceptional importance of branch interests that are involved in the distribution of the spring flow of the Volga and the concrete peculiarities of national economic situation, the commission considers it expedient to continue in the future the practice of discussing the conditions of spring releases from the Volgograd water reservoir on a high interdepartmental level, especially with the expected water shortage.

The commission also stated that the lack of methods for optimal distribution of the Volga's spring flow that are scientifically substantiated with economic criteria makes it possible to evaluate objectively and reliably the damage caused to various branches of the national economy and, consequently, to correctly designate the amount of the spring release. Therefore it was recognized as expedient to continue the work being done at the ENIN imeni G. M. Krzhizhanovskiy for determining the economic effectiveness of the releases into the Lower Volga and to organize extensive discussion of it with the participation of all interested ministries and departments. It was recommended that institutes of the USSR Academy of Sciences be enlisted in the methodological development for estimating the optimal releases along with departmental research organizations.

The following basic conclusions can be drawn from what has been said.

1. At the present time the Volga water management system does not have a homogeneous administrative structure; while above Volgograd most of the Volga flow is regulated by a cascade of water reservoirs and controlled water management

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has been created, below Volgograd there are still essentially extensive forms of management which appeared under the conditions of natural, unregulated flow and they have not been changed completely in keeping with the new conditions. Only in years with plentiful precipitation (when it supplies less than 10-15 percent of the water) do favorable conditions arise for the majority of branches of the complex and in other years all branches of the economy of the Volga water management system sustain large losses.

- 2. In the next few years it will be necessary to eliminate the disproportion in the economy that has been noted. Taking into account the fact that the Volga-Akhtuba floodplain, the Volga Delta and the Northern Caspian are important regions of the country for the reproduction of valuable commercial fish, and also the fact that the soil and climatic conditions of this region contribute to the development of highly productive agriculture here, it is necessary to create controlled fishing and agriculture in this region on the basis of effective utilization of the water divider and the development of technically improved devices for reclamation of agricultural land.
- 3. Controlled water management in the Volga water management system depends largely on the effectiveness of the prediction of the spring inflow of water, adjustment of the predictions and also the existence of substantiated methods for economic evaluation of the effectiveness of comprehensive utilization of water resources.
- 4. A solution to the problem of efficient optimal administration of the Volga water management system requires the development of a system of mathematical models and the development of research for obtaining initial information, including with the help of space methods. Such a system of models can serve in the future as the basis for the creation of an automated control system for the Volga water management system, the need for which will increase as the water management becomes more taut.

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11772

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RIVER REVERSAL PROJECT DISCUSSED BY TURKMEN GEOGRAPHER

Ashkhabad TURKMENSKAYA ISKRA in Russian 15 Apr 81 p 3

[Article by A. Zhumashov, candidate of geographical sciences and senior scientific worker at the Turkmenistan Scientific Research Institute of Soil Science: "A Reliable Forecast"]

[Text] The Soviet republics of Central Asia and Kazakhstan have great opportunities at their disposal for further economic and social development. This includes favorable natural-climatic conditions, the availability of labor resources and most important--vast areas of fertile land. In Turkmenistan alone, 12-13 million hectares are suitable for irrigation and yet only 1 million of these hectares have been so developed.

As is known, the principal sources of water in Central Asia are the Amudar'ya and Syrdar'ya rivers. However, computations show that based upon the present rates for land development the water resources of these rivers will be completely exhausted by 1990. Moreover, it should be borne in mind that the water supplies in Central Asia permit the irrigation of no more than 8.5 million hectares, whereas the land available in this region is three times greater than this. Thus, in 10 years time it will be impossible to expand still further the areas under crops in Central Asia and Kazakhstan. Equal importance is also attached to the fact that less and less water from the Amudar'ya and Syrdar'ya rivers is reaching the Aral Sea and the level of the latter is thus dropping at a rapid rate. In particular, this is being accompanied by the destruction of many plant communities, by the disappearance of hundreds of thousands of square kilometers of pasture, by the loss of fishing resources and by other unpleasant consequences.

The problem with regard to searching for an additional source of water for Central Asia and Kazakhstan has become very acute. A portion of this water can be obtained through more thrifty use of water and yet this will not solve the problem fully. As a result of thorough analysis, the need was recognized for diverting a portion of the Flow of Siberian rivers to this region.

The "Principal Statutes With Regard To Diverting a Portion of the Flow of the Siberian Rivers Into Central Asia and Kazakhstan" were developed during the past few years and they have been approved by the State Commission of Experts of USSR Gosplan.

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The general planner for the Siberian-Kazakhstan-Central Asian Canal -- the Soyuzgiprovodkhoz Institute of the USSR Ministry of Land Reclamation and Water Management -- with participation by more than 150 scientific research and planning organizations throughout the country has already performed a considerable amount of work. Of several variants for the route of the future canal, the most acceptable is the one where the water intake is carried out at the confluence of the Ob' and Irtysh rivers. The technical-economic justification for the first phase of the canal has been presented to the State Committee of Experts of USSR Gosplan. The plans call for the water to flow through the canal, built parallel to the Irtysh River, into the Tobol'sk Reservoir. From here it will be delerered by means of pumps via the Turgayskoye Depression to the south and reach the Syrdar'ya River in the region of the city of Dzhusaly. Subsequently, it will flow between Tuyamuyun and Takhiatash to the Amudar'ya River. The first phase of the main canal will be completed here; the canal will be continued across the territory of Turkmenistan to the Caspian Sea. The overall length of the future canal to the Syrdar'ya River -- 1,725 kilometers and to the Amudar'ya River -- 2,270 kilometers. Initially the canal will supply 25 cubic kilometers of water annually and eventually -- up to 60.

The "Basic Guidelines for the Economic and Social Development of the USSR During the 1981-1985 Period and for the Period Up To 1990" call for the continuation of scientific and planning work aimed at diverting the water of Siberian rivers into Central Asia and Kazakhstan. This is understandable. Indeed, such diversion work is a very serious undertaking and one which requires thorough consideration of all of the "pros" and "cons" and the prevention of possible adverse consequences.

One vital task at the present time is that of forecasting possible changes in the natural complexes as a result of such diversion work. Only a reliable forecast will make it possible, in a timely manner, to erect a barrier in the path of undesirable phenomena. Special studies are being carried out in this regard in both Central Asia and Kazakhstan. Since 1977, such studies have been underway at the Turkmen Scientific Research Institute of Soil Science and at an association of Turkmensel'khozkhimiya. The scientists of our institute must furnish an evaluation of the changes in the soil-reclamation status of the territory of Turkmenistan in the zone affected by the redistribution of the flow and develop recommendations for preventing adverse effects of the diversion, improve the fertility of the soils and raise their productivity. The zone of the Karakum River was selected as an analogue.

A group of scientists created for this purpose exposed a number of changes which had taken place over a period of 20 years of land reclamation development, changes which had to be taken into account in the forecast. With the arrival of the Amudar'ya water in the interfluvial areas of the Amudar'ya-Murgab and Murgab-Tedzhen rivers, the entire complex of physical-geographic factors on the piedmont plain of Kopetdag changed -- relief, plant cover, animal world, hydrogeological conditions, water-salt regime of the soils and so forth.

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The Karakum Canal is being built with no waterproofing of the bed. Thus, as a result of filtration, the surface water level in the zone of the canal rose from a depth of 10-25 meters to 1-3 meters. At the same time, an increase is taking place in the overall mineralization of the surface waters. The maximum width of the zone of influence of the canal in the regions of the settlements of Karametniyaz and Nichka, for example, reaches 40-45 kilometers in a northern direction and 10-35 in the remaining sectors. As a result of the operation of the first phase of the canal, the sandy-desert soils in some sectors are being transformed into meadow soils having varying degrees of salinity. To the north and northeast of the Karakum Canal, numerous filtration lakes have appeared. The biological productivity of the natural pastures is decreasing, while their usage is being intensified. The salinization of territories adjoining the canal continues.

The filtration processes are exerting a direct effect with regard to a change in the mineralization of the water in the canal itself. Our studies have established the fact that an increase in the mineralization of water is being observed along the length of the canal. For example, in June 1978 the salt concentration in the second phase of the canal was 0.48 grams per liter and in the third phase it had increased to 0.68 grams per liter. When such water is used for irrigation purposes, 6-10 tons of salt per hectare are added to the soil's thickness annually. In the absence of artificial drainage, salinization and water-logging of land irrigated by this water will occur roughly 5 years following the commencement of irrigation.

The land of a large portion of the flatland territory of Turkmenistan, deemed suitable for development, consists of loose and mainly sandy-loamy types of deposits. Thus, there can be no doubt regarding the threat of a sharp rise in the surface waters in northern, northwestern and southwestern Turkmenistan and in a portion of the piedmont plain of Kopetdag, coincidental with the arrival in these areas of the Siberian water. One can only conclude that the construction of the new canal on the territory of our republic must be accompanied by water-proofing measures. Moreover, with the development of the lands in these regions, it will be necessary to build collector-drainage systems and to line the intrafarm canals on a more extensive scale.

However, for a forecast of the soil reclamation changes caused by irrigation to be sufficiently complete, a great amount of work still remains to be carried out. A network of basic experimental farms should be organized in the republic, the land of which should consist of the principal types of our soils. Indeed, different changes will take place in the takyr-type and sandy-desert soils. Here, on the land of experimental farms, studies will be carried out on the water and salt regime of soils and on the water and physical properties involved in the cultivation of various crops -- cotton, corn, alfalfa and so forth. There is obviously a need for increasing the small number of individuals presently working at the institute on problems associated with the diversion of the Siberian waters. If this is not done, it will be impossible to develop a reliable forecast of the consequences of irrigation.

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It is also considered advisable to create a scientific center in Turkmenistan for coordinating the entire complex of studies associated with diverting the Siberian rivers into the territory of our republic.

It is believed that the solving of these organizational problems must not be postponed any longer.

7026

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POSSIBLE CHANGES IN ENVIRONMENT AND ITS PROTECTION IN SPHERE OF ACTIVITY OF DIVERTING PART OF THE STREAMFLOW ON EUROPEAN TERRITORY OF USSR

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA in Russian No 2, Mar-Apr 81 pp 23-29

[Article by R. Z. Gareyshin, T. V. Zvonkova, Yu. S. Kozhukhov, V. P. Chizhova and L. G. Shvidchenko]

[Text] The interzonal diversion of part of the northern river flow into the southern regions of the European territory of the USSR (ETU) is the largest project of regional transformation of the environment. The first phase of this unique project stipulates the supply of about 20 $\rm km^3$ of water per year.

The urgency of diverting part of the streamflow to the southern ETU is determined first of all by national economic importance, the need for further development of industrial centers, expansion of the areas of irrigated lands in the near future to 5 million ha, and improvement in the water supply of many cities.

The results of water-balance calculations for the river basins that were done by the planning organizations indicate that in the near future, even with the minimum development plans for irrigated farming, the negative stream flow balance will encompass many lowland rivers in the south of the country. As compared to the middle region (West Siberia, Kazakhstan, Central Asia), diversion of part of the streamflow to the ETU is in a more advantageous position, since here there is experience of operating interbasin diversion systems in recent decades. Their total volume reaches almost 14 km³ per year [2]. The use of the available hydrosystems of the Volga-Kama cascade and the Volga-Baltic water route for diversion of part of the northern waters will considerably reduce the capital investments for implementation of the project and the related undesirable changes in nature. But, despite the technical conditions for diverting part of the northern waters to the southern ETU that are favorable on the whole, one should expect the development of certain negative natural processes. According to preliminary data, the areas with direct and indirect undesirable changes will amount to tens of thousands of square kilometers. One should first of all note such unfavorable natural processes as swamping and secondary salinization that result in degradation of individual components in the natural complexes, their transformation, and often complete replacement with other less productive complexes. An especially important element in the problem of diverting part of the streamflow is therefore the development of scientifically substantiated forecasts for its effect on natural complexes and trends for the chief environmental protection measures.

93

The multiple-plan nature of the streamflow diversion problem determines the need to use a set of intersystem methods of research. The East European plain region must be viewed as a single natural system that is significantly urbanized and already partially transformed by the interbasin redistribution of streamflow and hydraulic engineering structures.

Analysis of possible changes in the environment during diversion of part of the streamflow of the northern rivers to the southern regions was done in three stages. At the first, retrospective stage, the hydroclimate and geological-geomorphological factors were analyzed in the development of the ETU environment in order to define the stable trends in its past evolution (long-term trends within the Holocene and medium-term in the past 50 years). At the second stage, an estimate was made of the modern trends of environmental evolution, especially the manifestation of extreme natural processes that could cause deviations from the normal, as well as natural processes of engineering value that could be activated after implementation of the project. At the third, strictly forecasting stage, the detected trends in the evolution of the environment were extrapolated for 25-30 years ahead. Analog plans are used here.

This article concentrates attention on the southern ETU regions. It does not examine special questions concerning the problems of shipping and the hydrobiology of the northern seas.

The combination of relatively distinct and stable for the predictable period, determined and elemental natural processes made it possible to separate local sections on the ETU with unfavorable manifestation of natural processes of engineering, ecological and environmental protection importance. The territories where the trends of development of the natural processes coincide with hydraulic engineering processes that are analogous to them are especially unfavorable. These sections are, in particular, the Vozhe-Kubenskiy depression and the Sukhona River headwater where active current descent of the territory is accompanied by intensive swamping. After diversion of part of the streamflow, intensification of this process should be expected.

In the historical past (Pleistocene), the natural cyclicity, the maximum natural contrasts, and changes under the influence of hydroclimate factors were peculiar primarily to the water and hydromorphic landscapes of the ETU middle zone. These same landscapes will be changed to the greatest degree under the influence of anthropogenic factors.

In the last decade, the southern slope of the East European plain has been distinguished by a considerable fluctuation in precipitation and temperatures with a certain directivity towards an increase in the shortage of precipitation and rise in the average annual temperatures. This trend will apparently dominate to the end of this century. All of this determines the importance of diverting part of the streamflow not only as a major national economic, but also environmental protection measure.

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One can isolate four predicted natural-hydraulic engineering regions according to the degree and nature of change in the environment and natural complexes on the route of the first phase of streamflow diversion: region of removal of part of the streamflow, water accumulation and regulation of streamflow; transit; run-off and redistribution. Within this region, territories are isolated with different reactions of the natural complexes to additional moisture, with a change in the natural complexes, their transformation, and local changes in the natural components and processes.

The northern, excessively wet slope of the East European plain within the limits of the forest, forest-tundra and tundra zones belongs to the region for removal of part of the streamflow. The most characteristic environmental trends of this region are the intensifying continental nature of the climate and a certain reduction in the natural moisture content. Withdrawal of part of the streamflow totalling about 20 km³ of water from Lakes Onega, Vozhe and Lacha, the Sukhona and Pechora Rivers will promote the deepening of these processes. The territories that adjoin the donor river valleys will suffer more than others. The natural complexes of these regions will be transformed towards an intensification of the tundra and forest-tundra elements in the landscape structure.

Changes in nature in the region of water accumulation and streamflow regulation that encompasses the valley of the Sukhona River, the Volga-Baltic water route, and the Pechora headwaters will be comparatively small and local. They will be manifested primarily in the rise of the ground water level and the swamping of forests in and around the valleys in the upper reaches of the Pechora, in the region of construction of the regulating hydrosystems. Here the greatest area (up to several tens of thousands of hectares) of flooded and partially submerged lands is expected. A considerable percentage of them are agricultural land assets and high-quality forests. When the floodplains and parts of the low platforms of the Sukhona River are flooded, the willow-grassy, grassy-green birch-aspen, coniferous-small-leaved swamp grass forests will be wiped out while the spruce green and birch-spruce sedge-mossy and pine long-bearing forests of the high platforms will change with an increase in the percentage of swamped types of forests and swamp complexes. The reconstruction of the natural complexes in these regions will be especially intensive in the first 10-15 years.

The transit region encompasses the Volga-Baltic canal, the Rybinsk reservoir, the Volga and Kama Rivers. There should not be any significant changes in the environment of this sector. An increase in the volumes and frequency of passages through the Volga and Kama reservoirs will somewhat activate the earth creep processes, especially on the right bank of the Volga River from Kazan' to Volgograd. According to the data of Ye. G. Kachugin, the stability of the slopes in the region of Ul'yanovsk during decreases in the reservoir level is reduced by 20%, [3]. During variable regimes of the reservoir level, abrasion is also activated. For the Kama and Volga reservoirs, the total extent of the abrasive shores is currently roughly 4,000 km. After the Cheboksary and Nizhne-Kama reservoirs are put into operation and part of the streamflow is diverted, it will increase even more. In the transit region, positive hydrological and hydrobiological changes will dominate. An increase in the water flowage in the reservoirs, and its more frequent renewal will have a favorable effect on the processes of self-purification of the rivers, attentuation of eutrophication of the reservoirs, and improvement in the habitat conditions for water fowl and water supply for the cities.

The territory of the region for the streamflow and redistribution of part of the streamflow is the most dangerous for natural conditions and hydraulic engineering functions in relation to the dimensions of the expected changes. This is linked not only to the complexity of the natural conditions of the arid zones, but also with the possible disruption of the operating pattern of the irrigation systems. Here one can expect changes not only of a local but also of a regional order.

The almost universal irrigation and flooding of this territory significantly transforms its hydrothermal and geochemical conditions. Because of the increased evaporation from the surrounding territories, the air humidity can probably be increased by 10-20% and the air temperature in the vegetation period decreased by $1\text{-}2^\circ$. Wetting of the soils and intensified sod processes will promote a decrease in the probability of dust storms and attenuation of the erosion processes.

Considerable changes are expected in the west Caspian region (Sarpinskiy and Terskiy-Kumskiy physical-geographical provinces), Prikuban'ye and lower Don. Local changes will be associated with the zones of influence of the new main canals, Volga-Ural, Chograyskiy, Dagestan, Rostov-Krasnodar and North Stavropol'. Processes of secondary salinization represent the greatest danger here.

Changes in the Volga-Akhtubinsk floodplain and the Volga delta will primarily be positive. Additional wetting of this territory will permit partial restoration of the lost natural potential of the floodplain and the lower reaches of the river. It will increase the yield of the meadows and improve the fish spawning conditions in the delta, as well as the conditions for water supply to Astrakhan. But taking into consideration that over 90% of the diverted water will be collected for irrigation even before the Volga-Akhtubinsk floodplain, one cannot count on complete restoration of the hydromorphic complexes of the floodplain. The areas of land to be irrigated here will increase at the same time.

The first phase of diverting part of the streamflow does not provide for complete resolution of the problems of the Caspian and Azov Seas. The national economic importance of these reservoirs is not less than the introduction of new areas of irrigated land. Even today, therefore, there is a need for diverting 70-80 km³ of water per year from the beginning of the next century with regard for the need of the Caspian Sea [1].

In addition to planned transformations of nature in the sphere of influence of the streamflow diversion, changes are also possible in the conditions for functioning of the industrial complexes, conditions of city designing and building, and the structure of the territory's use. Changes in the conditions of city designing and building will chiefly be expressed in an improvement or deterioration of the natural conditions for conducting certain construction work. Drastic changes in construction conditions are possible on limited areas near the water bodies.

Analysis of the possible rise in cost of major construction in the ETU after streamflow diversion shows that in the western, extreme northern, part of the southwestern and southern physical-geographical provinces, changes in the cost of city designing and building are not foreseen. Here the effect of the diversion either will not be felt at all, or its negative and positive factors will be mutually exclusive.

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In the majority of provinces of the Cis-Ural region, Volga region, Ukraine, partially in the North Caucasus, the cost of city designing and building also will not change. Moreover, it can drop in certain regions because of improved water supply. In the southeast provinces, improvement in the climate situation, water supply conditions and landscaping will promote a decline in the cost of city designing and building. Only in the central, northern and northeastern provinces is a deterioration in the natural conditions for construction expected because of the increased level of subsoil water, swamping and rising of ground water. The greatest deterioration is expected in the southern section of the Pechora province (to 2-4%). However, the rise in cost for the region as a whole is comparatively insignificant (to 1%). If one takes into consideration that the extant rise in cost of city designing and building in these provinces is from 6 to 20%, then the relative increase, as a rule, will not exceed 10%.

Thus, diversion of part of the flow of the northern rivers to the south will elicit, on the one hand, a slight increase in the cost of city designing and building because of the natural conditions in the northern, partially central regions, and on the other hand, will somewhat reduce the cost in the southern and southeastern regions. On the whole for the ETU, the rise in cost will remain on roughly the same level.

The routes for diversion of part of the streamflow of the northern waters will pass through the regions that differ significantly both in structure of the territory use, and in their degree of development. These regions will react differently to the delivery of additional volumes of water. Analysis of the spatial structure of territory use shows that on the whole, the effect of the first phase of streamflow diversion on the intensity of development of the adjacent lands will be weak. The lands of new irrigation will remain poorly developed, although the rates of their development will be somewhat accelerated. This is explained by the poor degree of preparation of the land of future irrigation for reception of water.

In the strongly developed regions, the potential value of the territorial and water resources is considerably higher than in the poorly developed. Therefore, the water that is diverted from the north can be used here much more efficiently. One can expect a higher yield from the capital investments made to divert part of the streamflow, and their rapid compensation from the use of the water not only for irrigation, but also for production and household needs for the industrial regions.

The system of environmental protection for the territory that is included in the zone of influence of the streamflow diversion is formed of three interrelated parts: protection of the environment as a whole; protection and restoration of the intensively employed part of the environment, natural resources, and protection of especially preservable natural territories. Analysis of the expected changes in the environment and the modern network of preservable natural territories shows that some of the preservable territories will partially or completely fall into the zone of influence of the planned hydraulic engineering and irrigation stru ures after the streamflow diversion. On the

southern slope of the East European plain, 4 preserves, 28 sanctuaries and 9 future national and natural parks belong to these objects. Depending on the local natural conditions and the strength of the effect from hydraulic engineering structures, the changes in the natural complexes of the preservable territories will be either positive or negative.

The majority of preservable territories will experience a favorable effect from diversion of part of the streamflow. This is associated with the fact that a considerable part of the preserves and sanctuaries on the diversion route have been created to protect acquatic game. The positive effect will also be expressed here in an improvement of the water exchange conditions and the processes of water self-purification, and restoration of the hydromorphic complexes of the southern sanctuaries.

Diversion of part of the streamflow will have the greatest positive effect on the natural complexes of the Astrakhan preserve. They are currently being gradually degr ded mainly because of the intensified aridity and drop in the Caspian Sea level. The effect of the decreased Caspian Sea level is presented in the form of a chain of cause-effect phenomena: regression of a shore line-formation of sections of saline ground on areas exposed from under the seareduction in the shoal zones--decrease in productivity of the feed lands--decrease in numbers and species of water fowl. The territory of the Astrakhan preserve is also overgrown with dense aquatic-swamp vegetation which impairs the fish spawning conditions. Studies by colleagues of the preserve showed that the delta has been especially actively overgrown with bur reeds, reeds and other aquatic communities in the last 5-7 years [4]. This curtails the area of feed land and impairs the habitat conditions for water fowl. It reduces the reserves of fish, in particular, the sturgeon.

Although diversion of part of the streamflow will increase the water content in the lower water period of the delta, this problem will not be completely resolved. The only possible escape from the situation for the Astrakhan and other Caspian preserves is stabilization of the Caspian Sea level at the optimal mark for the aquatic biocenoses, 28.7 m. This would currently require about $15~{\rm km}^3$ of water per year above the volumes necessary to compensate for the rise in water consumption in the Caspian basin [1].

Protection of the natural complexes of the absolute sanctuaries excludes the possibility of using normal measures of engineering and phytomelioration protection. In this case, a certain change can be recommended in the profile of the scientific studies on the preserves, for example, broadening the program of research to investigate the effect of hydromorphization processes on the structure of the natural complexes of the preservable territories. In the future, when the volumes of northern river diversion double, one can expect an intensified unfavorable effect not only on the environment as a whole, but also on the natural complexes of the preserve territories. Consequently, more detailed studies are required to determine: a) possible indirect and regional changes in the environment; b) permissible limits for the change in the natural complexes; c) means of restoring the disrupted blocks of natural complexes and protecting the especially preservable natural objects.

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Under these conditions, it becomes especially valuable to set up expanded stationary observations of the dynamics of natural complexes and natural processes in the preserves and sanctuaries after, or according to the example of "biospheric preserves."

Despite the complexity of the problem of protecting natural complexes of the preserves, foresight of the necessary environmental protection measures even before technical implementation of the streamflow diversion project will permit prevention of their many negative changes.

Damage to the environment on the ETU can be reduced in principle:

- 1. By planning measures, for example, reduction in the network of canals and their length by filling the shoaling rivers with water, decrease in the number of reservoirs in the southern ETU, reduction in the areas of evaporation and filtration by decreasing the flooded areas, etc.
- 2. Control of the river regime for environmental protection purposes, for example, determination of the correlation between the volumes of water to be withdrawn from the rivers, and its fluctuation in the basins in different years; preservation of the flood water regime, especially on the sections with good natural drainage and absence of backwater; preservation or improvement in the self-purification capacity of the reservoirs and adjoining territories, including, by artificially created flushing regime.
- 3. Substitution of certain elements in the environment that have been damaged by the streamflow diversion, for example, replacement of the natural composition of flooded forests with more water-resistant species.
- 4. Direct engineering and phytomelioration protection of natural and hydraulic engineering objects that have been disturbed by the streamflow diversion, protection of shores from erosion, vertical drainage on salinized land, protection of reservoirs from silting up and overgrowth, planting of forests, change in the parameters and designs of hydraulic engineering structures, improvement in the waterproofing, etc.
- 5. Use of compensation environmental protection measures, substitution of flooded and partially submerged agricultural lands with appropriate lands in other parts of the basins, change in the management profile of the kolkhozes and sovkhozes; creation of artificial floodplains in the main canals to replace the natural meadows when the flood regime of the rivers is reduced, and restoration of the drowned river valleys in the south.

When the volumes of streamflow diversion are increased to 60 km³ per year and more, additional studies are needed: on possible indirect changes in the environment outside of the sphere of direct influence of the canals and reservoirs, resolution of the problem of protecting the environment on the southern slope of the ETU as a whole, as well as means of restoring certain natural resources and protecting the especially preservable natural objects.

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NEED FOR REDISTRIBUTION/DIVERSION OF WATER BETWEEN VOLGA AND URAL RIVERS DISCUSSED

Moscow VODNYYE RESURSY in Russian No 2, 1981 pp 72-76

[Article by A. P. Musatov, Institute of Water Problems, USSR Academy of Sciences, and Yu. N. Podushko, All-Union State Planning, Surveying and Scientific Research Institute of Water Management Construction]

[Text] The great significance of the Urals-Caspian fisheries region [2, 5] is determined by the high catches of sturgeon,* 90-95 percent of which is starred sturgeon.

The spawning run of sturgeon to the Ural River increased sharply during the past two decades, while an increase of catches in the river began after regulation of the Volga flow near Volgograd and construction of the Iriklinskoye Reservoir, i.e., even during fishing for sturgeon in the sea. By the mid-1970s, the fishing industry region under consideration supplied almost one-third of the world catch of sturgeon. In 1976 the specific catch of starred sturgeon in the Ural River (on 1 km³ of its flow) comprised 2,000 tons, while that in the Volga was one-half as much.

A total of 70 sturgeon spawning grounds with a total area of approximately 1,700 hectares has been counted in the Ural River from Gur'yev to Ural'sk, of which more than 900 hectares are channel sections that are permanently under water, while the remaining spawning grounds are flooded only during the flood season. Thus, the potential area of the spawning grounds in the Ural River is almost four times higher than that on the remaining free section of the Volga River below Volgograd (approximately 480 hectares).

Fluctuations of the water content of the Ural River determine the conditions of the run of sturgeon into the river and their passage to the spawning grounds. The length of the spawning section, the conditions of the spawning grounds, the periods of spawning, the survivability of the young and the scales of predation by predators and also the duration of migration of the young depend on fluctuations of the water content of the river. The characteristic feature of the river is high variability of its flow (from 2.6 to 24.6 km³/ year at the Kushum gauge), due to which the spawning grounds are flooded extremely irregularly in spring. It is important to note that adequate inundation of these spawning grounds is observed at flow exceeding 5 km³/year.

101

^{*}Prior to 1965, sturgeon were caught both in the river and in the sea, but later only in the Ural River.

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The sturgeon spawning grounds most valuable in quality of bottom deposits are located above the village of Kalmykovo (1,000 hectares). However, they are now being rather weakly developed and mainly by sparse winter forms of beluga and sturgeon. They are not easily accessible to starred sturgeon (especially during dry years) due to the early onset of spawning temperatures in the river. Organization of free passage (without early catch) of producers at the beginning of the spawning run is required to increase the effectiveness of developing these sturgeon spawning grounds, which will significantly improve the conditions of natural reproduction in the river. The norm of passage of the starred sturgeon into the river should apparently be scientifically based as a function of the water content of individual years.

The main mass of sturgeon spawns in the section of river below the village of Chapayevo where the area of the spawning grounds amounts to 1,000 hectares. During dry years, judging by the fact that bream and Caspian roach in the Ural delta feed on sturgeon eggs [3], spawning occurs even in the delta itself.

The spawning grounds below the village of Kulagino (with an area of 400 hectares) play a less important role in reproduction of the sturgeon than those located farther upstream. The survivability of the young migrating from these grounds, being of small size, is rather low. Accordingly [4], the main mass of sturgeon young migrates from the Ural river in the form of larvae during dry years, especially during an early spring. It should be noted that feeding on the young by predators is activated during years when the delta is not filled (and these years have predominated during the past few decades).

The yield of sturgeon apparently correlates with the yield of river and semitransient fish, for which years with flow of the Ural exceeding 9 km³ are favorable. The areas of spawning grounds of the Ural River decrease almost by a factor of 8 and yield decreases by a factor of 3-10 during dry years. All this indicates that a very important role belongs to the water content of the river in supporting the reproduction of valuable fish species.

The flow of the Ural River has no less effect on creation of favorable conditions for fattening of sturgeon and semitransient fish, adding fresh water to the adjacent pre-estuary zone of the sea. It should be noted that the Ural River has no buffer estuary reservoir and the few and small young of sturgeon and of small fishes immediately enters the salinized waters of the sea during dry years due to the sharp decrease of zones with salinity of 0-5 percent. During some years (for example, 1967), the equal-salinity lines of 10-12 percent directly approached the mouth of the river in the fall. The direction of the equal-salinity lines in the pre-estuary space indicates that practically the entire flow of the Ural River goes to the southwest during dry years; the areas of freshening in the eastern part of the sea area increase as the flow increases. The effect of the Ural River on the saline conditions of the pre-estuary region is felt most strongly with flow exceeding 10 km³/s. However, it is quite probable that the extent of river flow in freshening the eastern part of the sea will increase in the future with regard to the proposed reduction of the level of the Caspian Sea and weakening of the water exchange between its western and eastern parts.

102

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The highest and minimum productivity of the eastern part of the Northern Caspian Sea is observed accordingly when the wet and dry years on the Volga and Ural Rivers coincide.

In years when the flow of the Volga decreases, suitable conditions for life of hydrobionts in this section of the sea are created due only to the flow of the Ural. Thus, an increase of the Ural during low-water years could significantly stabilize the conditions for reproduction of valuable species of fish in the river itself and of their fattening in the sea.

The important role of the Ural River in formation of fish production of the Caspial Sea, on the one hand, and the sharp fluctuations of its water content inherent to the river, on the other hand, have long led water and fish management specialists to the idea of possible regulation if its flow [1].

Let us consider this problem in somewhat more detail. The extreme variability of the annual flow of the Ural River (the scope of fluctuations of 1:9) predetermines the instability not only of the water, but of terrestrial ecosystems as well (with the delta and floodplain of the river in mind). An increase of non-returnable water consumption in the Ural basin, still further reducing the flow of the river into the sea, as already indicated, has an unfavorable effect on reproduction of semitransient and sturgeon fish.

The Volga and Ural interfluve is a promising region for development of grain farming and highly productive animal husbandry. If one assumes that nonreturnable water consumption in the Ural basin will increase with development of this region, then the annual streamflow into the sea may amount to 5.3 km 3 during years with 50 percent provision, while it may decrease to 2.1 km 3 during years of 75 percent provision. We note in this case that the annual streamflow of the Ural River was not once below 3 km 3 and was below 5 km 3 in only six cases during the period from 1936 to 1966. An annual streamflow less than 5 km 3 can be observed for 17 years with agricultural development of the region and during 11 of these years it will be even below 3 km 3 . This low-water period can be repeated every 2-3 years.

The crop of sturgeon young during dry years, as already indicated, is decreasing. The river delta is essentially not inundated with screamflow less than 5 km^3 and is not used by semitransient fish; the conditions for wintering over of sturgeon in the river (on the section from Gur'yev to Ural'sk) are deteriorating with flow rates less than $100 \text{ m}^3/\text{s}$ during December-February.

The Iriklinskoye Reservoir located above Orsk has a major effect on the regime of the Ural River. In redistribution of streamflow during spring flooding, $1.7~{\rm km}^3$ of water are used to fill the reservoir, which in dry years has a negative effect on the reproduction of sturgeon and semitransient fish. However, an increase of flow rates 1.5-2-fold during the winter season (from November through March) due to releases from the reservoir is favorable for the hydrobionts inhabiting the river in winter.

If one proceeds from a possible increase of water consumption in the upper reaches of the Ural River, one must state that winter releases from the reservoir may support only the everyday flow rates of the river, which occur prior to the Iriklinskoye reservoir being put into operation.

The authors feel that maintaining the water content of the Ural River at optimum values is possible only if water from the Volga is supplied to it. The technical and economic justification for construction of the Volga-Ural canal to flood the Volga-Ural interfluve and to improve the water conditions of the Ural River has now been worked out.

The length of the canal is 425 km; it is planned to take in water from the Volgograd Reservoir (the Yeruslanskiy inlet or the open section near the village of Levchunovka), and to supply water to the Ural River in the region of Ural'sk. The first unit of water subsidies provides for an increase of winter flow rates up to $100~\text{m}^3/\text{s}$ in the Ural (from November through March) and a favorable oxygen regime in wintering-over holes is guaranteed. The volume of flow supplied through the canal will amount to 1.3 km³ a year, of which more than 1 km³ will fall into the sea. However, fishing industry requirements for a high water and annual streamflow of 75 percent streamflow privision (3.1 and 5.7 km³, respectively) will be only partially satisfied upon construction of the first phase of the canal.

Nor will fishing industry requirements for 75 percent streamflow provision be fully satisfied upon construction of the second phase of the canal: the volume of high waters will amount to 2.8 $\rm km^3$ while the annual streamflow will amount to 5.3 $\rm km^3$. Additionally 1.3 and 1.1 $\rm km^3$ of water, for which creation of an additional 1 $\rm km^3$ of regulating capacity is required, will be delivered via the canal into the Ural River in winter and spring respectively. The requirements of the fishing industry will be almost completely satisfied during years of 50 percent streamflow provision.

It should be noted that flooding the Ural River with part of the Volga flow can solve the problem of maintaining the given water quality in winter only on the section of river below the village of Kushum. Maintenance of the necessary water quality on the greater part of the river during winter (the 800-kilometer section from the Kushum gauge to the Iriklinskoye reservoir and above it, where the main water intake is accomplished and waste waters from industrial centers are discharged) only if the useful volume of the reservoirs in the upper flow of the river is increased by 0.5-1.0 $\rm km^3$ with compensation of the accumulated spring streamflow with a corresponding increase of the volumes of diversion of the Volga water through the Volga-Ural canal. This water should also be supplied to the lower reaches of the river in spring to provide the optimum conditions for fish reproduction.

The existing planned developments of the Volga-Ural canal are based on the need to maintain 75 and 50 percent streamflow provision in the Ural with volumes of 5.7 and 8.4 $\rm km^3$, respectively. However, the annual flow of the Ural River should be increased to 7 and 10 $\rm km^3$ during years of 75 and 50 percent provision, respectively, to optimize the regime of the eastern part of the Northern Caspian

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(especially with regard to the proposed decrease of the level of the sea) and creation of favorable conditions for reproduction of sturgeon. This requires an increase in the volumes of diverted streamflow mainly during the high-water season for which the regulating capacity of the reservoir must be increased by 1.5-1.7 $\,\mathrm{km}^3$ on the route of the Volga-Ural Canal.

The use of Lake Chelkar for these purposes, located on the left bank of the Ural River, is very promising. Its maximum depth is 12 meters, the area at the average annual water's edge is 190 km², 225 km² along the shore line and 205 km² at the water's edge in the wet year of 1967. The lake is fed by two riversthe Bol'shaya and Malaya Ankata, the flow of which amounts to an average of 78 million m³/year. The water-intake area of the lake, equal to 80 km², provides an additional average annual streamflow of 30 million m³. Only the Solyanka River flows out of the lake and only during those periods when the level of the lake does not drop below the 18.7 absolute meter mark; at lower levels the lake is without outflow. The level of the lake has now decreased more than 2 meters (compared to 1957), as a result of which its area and volume were reduced sharply (volume from 2 to 1.5 km³), while mineralization of the water reached 3-4 percent.

The amplitude of natural fluctuations of the water level in the lake amounts to 7 meters. The volume of water varies by 1.4 km 3 in this case. The natural regulating capacity of the lake may amount to approximately 1.5 km 3 . The water can enter the lake directly through the Volga-Ural canal and the old bed of the Solyanka River can be used to supply water into the Ural River.

As shown by preliminary calculations, a levee 5 meters high should be constructed along the banks to increase the capacity of Lake Chelkar by 1 km 3 (which makes it possible to do away with the flooding reservoir on the right bank of the Ural River). In this case the total regulating capacity will amount to approximately 2.5 km 3 , as a result of which the annual flow of the Ural of 75 and 50 percent provision will be increased to 7 and 9.8-10 km 3 , respectively. This guarantees optimum conditions of reproduction and fattening of sturgeon and semitransient fish in the eastern part of the Northern Caspian.

It should be emphasized that to maintain favorable conditions for habitation of commercial fish in the eastern part of the northern Caspian prior to the supplying of part of the Volga flow into the Ural River (especially with regard to the possible lowering in the level of the sea and increase in water consumption in the river basin) it is necessary to intensify delivery of Volga waters into the eastern part of the Northern Caspian with the help of a water divider in the Volga Delta and active exploitation of it fish passage channels.

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105

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6521

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GLOSSARY OF SELECTED TERMS

During the course of this project attempts were made to standardize translations of certain terms. Listed below as a further aid to the reader is a list of selected, pertinent Russian terms, along with their standardized translations. While the usage herein does not totally conform to this list, attempts have been made, and will continue to be made, to achieve the maximum possible degree of conformity.

ВОДНОСТЬ water content (rather than flow rate)

ВОДНЫЙ ОБЪЕКТ water body (rather than water source)

ВОДОПОТРЕБЛЕНИЕ water consumption

ЗАБОЛАЧИВАНИЕ swamping, flooding, becoming boggy

or marshy

ИЗЫМАЕМЫЙ withdrawn

M3H9TME withdrawal (rather than diversion)

ОСНОВНЫЕ НАПРАВЛЕНИЯ Basic Directions

OTTOK outflow

OTDEM removal

ПЕРЕБРАСЫВАЕМЫЙ diverted (rather than redistributed

or transferred)

NEPESPOCKA diversion or diverting (rather than

redistribute or transfer)

TUTAHUE feeding (rather than discharge)

ПОДАВАЕМЫЙ supplied

ПОДАЧА supplying or supply (rather than

diversion or diverting)

ПОДПОР head, backwater, affluent (of a river)

ПОДТОПЛЕНИЕ 1) rise in ground water level,

saturating with ground water;

2) partial flooding, partial submerging

ΠΟЙΜΑ (ΠΟЙΜΕΗΗΑЯ TEPPACA) flood plain

ПОПУСК discharge or release

107

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GLOSSARY OF SELECTED TERMS (cont.)

ΠΟCΤΥΠΛΕΗΜΕ delivery (rather than diversion or

diverting)

PACXOD discharge, rate of flow, flow rate

CGPOC runoff (in this context)

CPASOTKA decrease in storage, drawdown, draw off

CTOK flow or streamflow (rather than runoff-may be translated as runoff in some

contexts, however as used here meaning is flow or streamflow)

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Астраханское Центральное Конструкторское Бюро

RUSSIAN ACRONYMS

АЦКБ

Listed below are selected Russian acronyms which will prove useful to those wishing to pursue the study of Soviet river diversion projects.

•	week and the second of the sec
BPK	Влажность Разрыва Каппиляров
BXH	Водохозяйственный Комплекс
MO	Гидрометеорологическая Обсерватория
EBXCC	Единая Водохозяйственная Система Страны
ETC	Европейская Территория Страны
НИВ	Коэффицент Использования Воды
КПД	Коэффициент Полезного Действия
НПВ	Наименшая Полевая Влагоемкость
HUA	Нормальвый Подпорный Уровень
OBXC	Обединненая Водохозяйственная Система
OB .	Опреснение Воды
00	Обратный Осмос
ОУ	Опреснительная Установка
ПВУ	Передвижная Водоподемная Установка
ПДН	Предельно-Допустимая Концентрация
ппв	Предельная Полевая Влагоемкость
PH	Ращет Наскада
СВИН	Сточные Воды Животноводческих Номплексов
СПАВ	Синтетические Поверхностно-Активные Вещества
СПД	Слой Постояянной Дистилляация /Нонденсационный Слой/
CITT	Структура Почвенного Покрова

END